USER'S MANUAL

PIXCI® CL3D
Revision 2.1

08 August 2003

For use with:
PIXCI® CL3SD Rev. 2.0

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1. Installation

Thank you for purchasing imaging products from EPIX, Inc. We are available via the Internet, FAX, and telephone to help with installation or to answer questions about the use of our products for your application.

The PIXCI® CL3SD imaging board, for the PCI bus, is packed in a static dissipative bag. Please keep the bag and box in which the board was shipped should the need arise to return the board. Prior to opening the bag, place the bag near the PC into which the board will be installed.

We recommend installing XCAP prior to installing the PIXCI imaging board. Please refer to the Software Installation chapter for the XCAP installation directions, then follow the board installation instructions below.

Note that Windows 95, 98, or ME are NOT SUPPORTED.

1. Turn off the power and remove the cover from the PC into which the PIXCI imaging board is to be installed.

2. Select a vacant PCI bus slot and remove the metal bracket and screw covering the back panel slot with which it is aligned. Consult the reference manual for the PC if there is any doubt about which slot is a PCI bus slot.

3. Use of a static free area and a wrist strap connected to the PC or to the static free area is required during installation. Walking can generate static electricity. Keep your feet stationary while removing the PIXCI imaging board from the anti-static bag. Hold the bag and the PC at the same time, or place the bag on the PC chassis and hold the chassis to dissipate static charge that may have been created while transporting the board to the PC.

4. Remove the PIXCI imaging board from the anti-static bag and insert it into the PCI bus connector. This can require up to 15 pounds of force. Do not use too much force as the board may not be inserted into the connector correctly, and the result can be damage to the connector and the board. Consult the reference manual for the PC if there is any doubt about which slot is a PCI bus slot.

5. Replace the screw to secure the PIXCI imaging board in the slot.

6. Remove the power from all equipment to be connected.

7. Connect the cable(s) between the PIXCI CL3SD, camera, and power supply. Two identical Camera Link cables are used to connect data and control between the A504K camera and PIXCI CL3SD board. Note that the orientation of the cable ends between the camera and the board are such that the cable connecting to the top connector on the camera goes to the lower connector on the board. The rule is that the cables cross. Incorrectly connecting the cables will result in errors. The thumb screws on the connectors must be used to provide a proper electrical connection between the cable and the connector.

8. Power up the camera, PC, and monitor(s).

9. Operate XCAP by following the instructions in the Software Installation and Getting Started chapters in this manual.

10. Check for display of video on the graphical display system by clicking on the Capture and then the Snap menu in the View window or by using the shortcut menu.

11. If there is no video displayed, make sure that the camera communications are enabled in the Camera Adjust Menu, and make sure the camera is in the free run mode of operation. If the Video count reported in the View Menu is not increasing, check the connections and power to the camera. If that fails, refer to the "In Case of Trouble" chapter in this manual.

1.1. Motherboards

Most motherboards manufactured since 2001 should be compatible with the PIXCI CL3SD. EPIX, Inc. can supply a tested system with PIXCI CL3SD, camera, cables, camera power supply, and computer.

1.2. Graphics Display System

An AGP based graphics display adapter is recommended.

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2. Connectors

The PIXCI CL3SD imaging board has two 26 pin 3M MDR connectors for data and control between the A504k or A504kc camera. These two connectors are accessible thru the bracket that mounts the board to the computer chassis. Revision 2.0 of the board has an additional 6 pin LEMO connector thru the top of the bracket for trigger input and trigger output.

Two identical Camera Link cables are used to connect data and control between the A504K camera and PIXCI CL3SD board. Note that the orientation of the cable ends between the camera and the board are such that the cable connecting to the top connector on the camera goes to the lower connector on the board. Incorrectly connecting the cables will result in errors. The thumbscrews on the connectors must be used to provide a proper mechanical and electrical connection between the cable and the connector.

2.1. PIXCI CL3SD Bracket Connectors

Connector P5 is the round connector nearest the top of the bracket on the Revision 2.0 PCB. Connector P2 is the upper 26 pin MDR connector which connects to the lower connector on the A504K camera. Connector P1 is the lower 26 pin MDR connector which connects to the upper connector on the A504K camera. Note that the cables must have the thumb screws securely fastened for proper signal connection.

Note that the two 26 pin MDR cables are ``switched'' in their camera to board location with the top connector on the A504K going to the lower connector on CL3SD.

2.2. PIXCI CL3SD 10 Pin Header P3 Signal List

Two 10 pin headers are provided for connecting external and internal signals to the PIXCI CL3SD. The description for Header P3 follows.

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+5 VDC (0.75 Amp max)
Trigger In +	I	3	4	I	Trigger In -
Not Used	NC	5	6	NC	Not Used
CC4P-	O	7	8	O	CC4P+
Not Used	I/O	9	10	I/O	Not Used

The Trigger input can be used by software to start an image sequence capture and may also be used to generate the exposure signal to the camera with software controlled timing. The Trigger input receiver uses LVDS (Low Voltage Differential Signal) voltage levels and is terminated in 100 ohms between pin 3 and pin 4.

CC4 is used to provide a copy of the Trigger for multiple board synchronization. The driver output uses LVDS voltage levels.

Header P3 is for signals external to the computer case or internal to the computer case. External signals can be connected with a cable to 9 pin D-Subminiature connector thru a second slot with a bracket to mount the D-Subminiature connector. A differential to TTL conversion module and 2 meter cable are available for connecting a TTL trigger to the PIXCI CL3SD.

A 6 position LEMO EGG.0B.306.CLL connector, P5, which is mounted at the top of the PCI bracket, has the same signals as P3 for connecting trigger inputs and outputs. All connections are common to header P3.

Pin 1 is ground.

Pin 2 is +5 volts thru a 0.75 ampere thermally triggered resettable fuse.

Pin 3, Trigger In P, is a positive LVDS differential trigger input, which is also connected to pin 3 of P3.

Pin 4, Trigger In M, is a negative LVDS differential trigger input, which is also connected to pin 4 of P3.

Pin 5, CC4P, trigger output, is a copy of the negative differential trigger input for multiple board trigger.

Pin 6, CC4M, trigger output, is a copy of the positive differential trigger input for multiple board trigger.

The CC4P and CC4M output signals are copies of the Trigger In+ and Trigger In- signals for daisy chaining the trigger input from board to board.

2.3. PIXCI CL3SD 10 Pin Header P4 Signal List

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+5 VDC (0.75 Amp max)
OUT1	Out	3	4		Ground
OUT2	Out	5	6		Ground
IN1	In	7	8		Ground
IN2	In	9	10		Ground

Header P4 is for TTL input and output signals internal to the computer case.

Pin 1 of P4 is in the upper left position.

Pin 1 is ground.

Pin 2 is +5 volts thru a 0.75 ampere thermal fuse.

Pin 3, OUT1, is a general purpose TTL output.

Pin 5, OUT2, is a general purpose TTL output.

Pin 7, IN1, is a general purpose TTL input.

Pin 9, IN2, is a general purpose TTL input.

Any other connectors on the PIXCI CL3SD are for test purposes only.

2.4. PIXCI CL3SD Memory Sockets

Memory sockets are populated in pairs starting with SOCK0 and SOCK4 which, together, provide 1 gigabyte of memory. The next two sockets to be populated are SOCK1 and SOCK5. Micron 512 megabyte registered, synchronous, dynamic memory modules are used. The board and PC must have power removed before removal or installation of memory and the installation must carried out with static elimination procedures.

---

3. Software Installation

XCAP-Plus, XCAP-Std, XCAP-Ltd, or XCAP-Lite, are easy to install by following the instructions below.

While XCAP is easy to install, like most manufacturers of PC software, we recommend the precaution of performing a hard disk backup before installing XCAP.

3.1. For Windows NT

XCAP requires Windows NT Version 4 with Service Pack 3 or later. You must be logged on as Administrator, or have equivalent privileges, to complete the installation procedure.

1. Install Files:
    a. If XCAP is provided on diskette(s):
        i. Insert XCAP diskette #1 into the A: or B: drive.
        ii. Execute the `SETUP` program, from a command prompt, or via the Windows "Start", "Run":

```
> A:SETUP
or
> B:SETUP
```

        iii. Follow the installation program's directions, such as to select an installation directory, and insert additional diskettes (depending upon version) as instructed. The default installation directory is C:\XCAP.

b. If XCAP is provided on a compact disk (CD):

   i. If your PC is set to allow automatic execution of loaded CDs, the CD's interactive index program will be executed automatically. Otherwise, execute the index program, from a command prompt, or via the Windows "Start", "Run":

```
> Z:SETUP       (replace Z with drive letter for your CD)
```

   ii. Select "Setup PIXCI(R) Imaging Software" and "XCAP Imaging Application". Click "OK".

   iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

c. If XCAP is provided via the internet:

   i. Download:

```
ftp.epixinc.com/software/xcap_v22/XCAPWI.EXE
```

   from the EPIX, Inc. ftp site.

   ii. Execute the downloaded program, from a command prompt, or via the Windows "Start", "Run":

```
> XCAPWI.EXE
```

   iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

   iv. Delete the downloaded .EXE file from your PC's hard drive.

d. The installation procedure creates a new program group, containing XCAP and several .TXT files. The *.TXT files contain these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The PCITIPS.TXT file provides the *PC Configuration Tips*, with tips for resolving hardware and software conflicts.

2. Create Shortcut - Drag & Drop (optional):

   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.

3. Create Shortcut - Manual (optional):

   a. Right click on the Desktop.[1]

   b. Select "New".

   c. Select "Shortcut".

d. Set:

```
Command Line:   InstallDir \ XCAPWXX
Name:           XCAP
```

replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".

4. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

The printer port authorization key is approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface which happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

The USB port authorization key is approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

b. Run the authorization key utility program provided with XCAP by "Start", "Run":

```
> C:\XCAP\PROGRAM\HLDINST -install
```

c. Or, in command prompt mode, switch to the chosen installation directory:

```
> CHDIR C:\XCAP\PROGRAM
```

and execute:

```
HLDINST  -install
```

to run the authorization key utility program.

5. Install PIXCI® Imaging Board Driver:

a. If the PIXCI® imaging board's driver was not loaded when the PC was powered up (as described under *Hardware Installation*), instruct Windows to load the appropriate driver: Click "Start", "Programs", and "Windows NT Explorer". Within the chosen installation directory, such as C:\XCAP, find and highlight file DRIVERS\WINNT\EPIXXCWT.INF

(or EPIXXCNT.INF for version 2.0 and earlier). From the menu bar, select "File" and "Install".

6. Configure Graphics Display (S/VGA):

    a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the graphics display (S/VGA) is required for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is suggested for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Settings", "Control Panel", "Display", "Settings".

    b. Under "Start", "Settings", "Control Panel", "Display", "Effects", the "Show window contents while dragging" must be disabled.

7. Reboot Windows.

8. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.2. Windows NT Esoterica

3.2.1. Windows NT - Manual Installation

Use of EPIXXCWT.INF (or EPIXXCNT.INF for version 2.0 and earlier), above, provides automatic installation of EPIXXCWT.SYS (or EPIXXCNT.SYS for version 2.0 and earlier) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. The EPIXXCWT.SYS (or EPIXXCNT.SYS for version 2.0 and earlier) must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

```
C:\WINNT\SYSTEM32\DRIVERS
```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCWT  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCNT  (version 2.0-)
```

   This entry must contain:

```
ErrorControl  =  0x00000001
Group         =  "Extended base"
Start         =  0x00000001
Type          =  0x00000001
```

   and may, as described below, also contain:

```
PIXCI         =  "-IM <memorysize>"
```

   Create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCWT
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCNT
```

This entry must contain:

```
EventMessageFile = "%SystemRoot%\System32\IoLogMsg.dll"
TypesSupported   = 0x00000007
```

3. Shut down and restart Windows.

3.2.2. Windows NT - Status Buffer Memory Allocation

Under Windows NT, memory to maintain status on each frame buffer must be allocated during Windows' initialization.

The requested memory size must be specified in the Registry entry described above, using an entry named "PIXCI", such as:

```
PIXCI         =  "-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in Kbytes. If no memory size is specified, a default size of 16 megabytes is used. Windows must be rebooted for the new specification to take effect.

For the PIXCI® CL3SD, which has on-board frame buffer memory, memory reserved by this parameter is needed only for support of time stamping of captured frames, such as optionally used by XCAP's Capture - Video to Frame Buffers. Currently, 64 bytes are needed for each frame buffer.

For systems which also use other PIXCI® imaging boards, the allocated memory is used for frame buffers; requesting a small amount of memory may limit the resolution which can be captured by other PIXCI® imaging boards.

Windows NT limits the maximum amount of allocatable memory, dependent upon what other devices are installed, the total PC memory size, and other factors. Using the Control Panel's Device Manager to select Boot or System priority startup for EPIXXCWT.SYS (or EPIXXCNT.SYS for version 2.0 and earlier) allows more memory to be allocated than selection of Automatic startup.

3.2.3. Windows NT - Authorization Key - Manual Installation

Use of HLDINST.EXE, as described above, provides automatic installation of the printer port authorization key's driver, needed under Windows NT, for XCAP-Plus, XCAP-Std, and XCAP-Ltd (but not needed for XCAP-Lite). The following information allows manual installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

```
C:\WINNT\SYSTEM32\DRIVERS
```

2. The file HLVDD.DLL must copied to the Windows SYSTEM directory, typically:

```
C:\WINNT\SYSTEM
```

or placed within the XCAP installation directory, typically:

```
C:\XCAP\PROGRAM
```

3. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock
   ```

   This key must contain values:

   ```
   ErrorControl  =  0x00000001
   Group         =  "Extended Base"
   Start         =  0x00000002
   Type          =  0x00000001
   ```

   or, if using REGEDT32, the values should appear as:

   ```
   ErrorControl:REG_DWORD:0x1
   Group:REG_SZ:ExtendedBase
   Start:REG_DWORD:0x2
   Type:REG_DWORD:0x1
   ```

4. Shut down and restart Windows for the new registry entries to take effect.

5. If the authorization key is connected to a non-standard printer port, an additional entry may be required:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock\Parameters
   ```

   which contains a value:

   ```
   IoPortAddress0  = 0x????            (for REGEDIT)
   IoPortAddress0:REG_DWORD:0x????     (for REGEDT32)
   ```

   where the "????" is replaced with the parallel port's I/O address in hexadecimal. As before, Windows must be shut down and restarted.

3.3. For Windows 2000

1. Install Files:

   a. If XCAP is provided on diskette(s):

      i. Insert XCAP diskette #1 into the A: or B: drive.

      ii. Execute the `SETUP` program, from a command prompt, or via the Windows "Start", "Run":

      ```
          > A:SETUP
      or
          > B:SETUP
      ```

      iii. Follow the installation program's directions, such as to select an installation directory,

and insert additional diskettes (depending upon version) as instructed. The default installation directory is C:\XCAP.

b. If XCAP is provided on a compact disk (CD):

   i. If your PC is set to allow automatic execution of loaded CDs, the CD's interactive index program will be executed automatically. Otherwise, execute the index program, from a command prompt, or via the Windows "Start", "Run":

```
> Z:SETUP       (replace Z with drive letter for your CD)
```

   ii. Select "Setup PIXCI(R) Imaging Software" and "XCAP Imaging Application". Click "OK".

   iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

c. If XCAP is provided via the internet:

   i. Download:

```
ftp.epixinc.com/software/xcap_v22/XCAPWI.EXE
```

   from the EPIX, Inc. ftp site.

   ii. Execute the downloaded program, from a command prompt, or via the Windows "Start", "Run":

```
> XCAPWI.EXE
```

   iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

   iv. Delete the downloaded .EXE file from your PC's hard drive.

d. The installation procedure creates a new program group, containing XCAP and several .TXT files. The *.TXT files contain these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The PCITIPS.TXT file provides the *PC Configuration Tips*, with tips for resolving hardware and software conflicts.

2. Create Shortcut - Drag & Drop (optional):

   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.

3. Create Shortcut - Manual (optional):

   a. Right click on the Desktop.[2]

b. Select "New".

c. Select "Shortcut".

d. Set:

```
Command Line:   InstallDir \ XCAPWXX
Name:           XCAP
```

replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".

4. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

The printer port authorization key is approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface which happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

The USB port authorization key is approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

b. Run the authorization key utility program provided with XCAP by "Start", "Run":

```
> C:\XCAP\PROGRAM\HLDINST -install
```

c. Or, in command prompt mode, switch to the chosen installation directory:

```
> CHDIR C:\XCAP\PROGRAM
```

and execute:

```
HLDINST  -install
```

to run the authorization key utility program.

5. Install PIXCI® Imaging Board Driver:

a. Under Windows 2000, the Windows' Device Manager must be used for initial installation of the PIXCI® driver.

   If the PIXCI® imaging board was not yet installed, the first time Windows starts after installation Windows will notice the new device and inquire.

   The first time Windows 2000 starts after installation of the PIXCI® imaging board, a pop-up window with the message "Multimedia Video Controller" will flash by. Next a pop-up window with the message "Welcome to the Found New Hardware Wizard" will appear. Click "Next". Select "Search for the best driver for your device". Click "Next". Check the box for: "Specify a location". Enter path DRIVERS\WIN2K within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN2K, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WIN2K\EPIXXCW2.INF. Click "Next". A pop-up window will report that a "Digital Signature was not found". Click "Yes". A pop-up window with the message "Completing the Found New Hardware Wizard" will state that "This device is not configured correctly. (Code 1)"; this error indicates that the newly installed driver will be functional only after a reboot. Click "Finish" and reboot Windows.

   If the PIXCI® imaging board was already installed under Windows 2000, and "Cancel" was clicked when Windows started and announced the presence of a new "Multimedia Video Controller", then instruct Windows to load the appropriate driver. Click "Start", "Settings", "Control Panel", "System" (if "System" is not listed, click on "view all Control Panel options"), "Device Manager", and "Other Devices" or "Imaging Devices". Select "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Double-click on the entry to bring up the "Properties" window. Click the "Driver" tab, and then click "Change Driver", or "Update Driver". A pop-up "Welcome" window will appear, click "Next". A pop-up window with the messages "This wizard searches for updated drivers for:" and "PCI MultiMedia Video Device" or "PIXCI(R) Video Capture Board" will appear. Select "Search for a suitable driver for my device (recommended)". Click "Next". Check the box for: "Specify a location". Enter path DRIVERS\WIN2K within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN2K, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WIN2K\EPIXXCW2.INF. Click "Next". A pop-up window will appear stating that a "Digital Signature was not found". Click "Yes". A pop-up window with the message "Completing the Found New Hardware Wizard" will appear and may state that "This device is not configured correctly. (Code 1)"; this error indicates that the newly installed driver will be functional only after a reboot. Click "Finish" and reboot Windows.

6. Configure Graphics Display (S/VGA):

   a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the graphics display (S/VGA) is <u>required</u> for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is <u>suggested</u> for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Settings", "Control Panel", "Display", "Settings".

   b. Under "Start", "Settings", "Control Panel", "Display", "Effects", the "Show window contents

while dragging" must be disabled.

7. Reboot Windows.

8. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.4. Windows 2000 Esoterica

3.4.1. Windows 2000 - Manual Installation

Use of EPIXXCW2.INF (or EPIXXCNT.INF for version 2.0 and earlier), above, provides automatic installation of EPIXXCW2.SYS (or EPIXXCNT.SYS for version 2.0 and earlier) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. The EPIXXCW2.SYS (or EPIXXCNT.SYS for version 2.0 and earlier) must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

```
C:\WINNT\SYSTEM32\DRIVERS
```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCNT  (version 2.0-)
```

   This entry must contain:

```
ErrorControl  =  0x00000001
Group         =  "Extended base"
Start         =  0x00000001
Type          =  0x00000001
```

   and may, as described below, also contain:

```
PIXCI         =  "-IM <memorysize>"
```

   Create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW2
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCNT
```

   This entry must contain:

```
EventMessageFile = "%SystemRoot%\System32\IoLogMsg.dll"
TypesSupported   = 0x00000007
```

3. Shut down and restart Windows.

Under Windows 2000, the Windows NT driver EPIXXCWT.SYS can be, and was previously, used instead of EPIXXCW2.SYS. In contrast to EPIXXCWT.SYS, the EPIXXCW2.SYS is Plug & Play compatible.

3.4.2. Windows 2000/XP - Status Buffer Memory Allocation

Under Windows 2000/XP, memory to maintain status on each frame buffer must be allocated during Windows' initialization.

The requested memory size must be specified in the Registry entry described above, using an entry named "PIXCI", such as:

```
PIXCI         =  "-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in Kbytes. If no memory size is specified, a default size of 16 megabytes is used. Windows must be rebooted for the new specification to take effect.

For the PIXCI® CL3SD, which has on-board frame buffer memory, memory reserved by this parameter is needed only for support of time stamping of captured frames, such as optionally used by XCAP's Capture - Video to Frame Buffers. Currently, 64 bytes are needed for each frame buffer.

For systems which also use other PIXCI® imaging boards, the allocated memory is used for frame buffers; requesting a small amount of memory may limit the resolution which can be captured by other PIXCI® imaging boards.

Windows 2000/XP limits the maximum amount of allocatable memory, dependent upon what other devices are installed, the total PC memory size, and other factors.

3.4.3. Windows 2000/XP - Authorization Key - Manual Installation

Use of HLDINST.EXE , as described above, provides automatic installation of the printer port authorization key's driver, needed under Windows 2000/XP, for XCAP-Plus, XCAP-Std, and XCAP-Ltd (but not needed for XCAP-Lite). The following information allows manual installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

   ```
   C:\WINNT\SYSTEM32\DRIVERS
   ```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock
   ```

   This key must contain values:

   ```
   ErrorControl  =  0x00000001
   Group         =  "Extended Base"
   Start         =  0x00000002
   Type          =  0x00000001
   ```

   or, if using REGEDT32, the values should appear as:

   ```
   ErrorControl:REG_DWORD:0x1
   Group:REG_SZ:ExtendedBase
   ```

```
Start:REG_DWORD:0x2
Type:REG_DWORD:0x1
```

3. Shut down and restart Windows for the new registry entries to take effect.

4. If the authorization key is connected to a non-standard printer port, an additional entry may be required:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock\Parameters
   ```

   which contains a value:

   ```
   IoPortAddress0  = 0x????            (for REGEDIT)
   IoPortAddress0:REG_DWORD:0x????     (for REGEDT32)
   ```

   where the "????" is replaced with the parallel port's I/O address in hexadecimal. As before, Windows must be shut down and restarted.

3.5. For Windows XP

1. Install Files:

   a. If XCAP is provided on diskette(s):

      i. Insert XCAP diskette #1 into the A: or B: drive.

      ii. Execute the `SETUP` program, from a command prompt, or via the Windows "Start", "Run":

      ```
          > A:SETUP
      or
          > B:SETUP
      ```

      iii. Follow the installation program's directions, such as to select an installation directory, and insert additional diskettes (depending upon version) as instructed. The default installation directory is C:\XCAP.

   b. If XCAP is provided on a compact disk (CD):

      i. If your PC is set to allow automatic execution of loaded CDs, the CD's interactive index program will be executed automatically. Otherwise, execute the index program, from a command prompt, or via the Windows "Start", "Run":

      ```
          > Z:SETUP       (replace Z with drive letter for your CD)
      ```

      ii. Select "Setup PIXCI(R) Imaging Software" and "XCAP Imaging Application". Click "OK".

      iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

c. If XCAP is provided via the internet:

   i. Download:

      ```
      ftp.epixinc.com/software/xcap_v22/XCAPWI.EXE
      ```

      from the EPIX, Inc. ftp site.

   ii. Execute the downloaded program, from a command prompt, or via the Windows "Start", "Run":

      ```
      > XCAPWI.EXE
      ```

   iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is C:\XCAP.

   iv. Delete the downloaded .EXE file from your PC's hard drive.

d. The installation procedure creates a new program group, containing XCAP and several .TXT files. The *.TXT files contain these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The PCITIPS.TXT file provides the *PC Configuration Tips*, with tips for resolving hardware and software conflicts.

2. Create Shortcut - Drag & Drop (optional):

   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.

3. Create Shortcut - Manual (optional):

   a. Right click on the Desktop.[3]

   b. Select "New".

   c. Select "Shortcut".

   d. Set:

      ```
      Command Line:   InstallDir \ XCAPWXX
      Name:           XCAP
      ```

      replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".

4. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

   a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

      The printer port authorization key is approximately the size and shape of a printer cable's

connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface which happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

The USB port authorization key is approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

b. Run the authorization key utility program provided with XCAP by "Start", "Run":

```
> C:\XCAP\PROGRAM\HLDINST -install
```

c. Or, in command prompt mode, switch to the chosen installation directory:

```
> CHDIR C:\XCAP\PROGRAM
```

and execute:

```
 HLDINST  -install
```

to run the authorization key utility program.

5. Install PIXCI® Imaging Board Driver:

a. Under Windows XP, the Windows' Device Manager must be used for initial installation of the PIXCI® driver.

If the PIXCI® imaging board was not yet installed, the first time Windows starts after installation Windows will notice the new device and inquire.

The first time Windows XP starts after installation of the PIXCI® imaging board, a pop-up window with the message "Multimedia Video Controller" will flash by. Next a pop-up window with the message "Welcome to the Found New Hardware Wizard" will appear. Select "Install from a list or a specific location. (Advanced)". Click "Next". Select "Search for the best driver in these locations". Uncheck the box for: "Search removable storage media". Check the box for: "Include this location in the search". Enter path DRIVERS\WINXP within the chosen installation directory, such as C:\XCAP\DRIVERS\WINXP, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WINXP\EPIXXCW2.INF. Click "Next". A pop-up window will report that a "The software that you are installing ... has not passed compatibility testing". Click "Continue Anyway". A pop-up window with the message

"Completing the Found New Hardware Wizard" will state that "The hardware you installed will not work until you restart your computer." Click "Finish" and reboot Windows.

If the PIXCI® imaging board was already installed under Windows XP, and "Cancel" was clicked when Windows started and announced the presence of a new "Multimedia Video Controller", then instruct Windows to load the appropriate driver. Click "Start", "Control Panel", "Performance and Maintenance", "System", "Hardware", "Device Manager", and "Other Devices" or "Imaging Devices". Select "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Double-click on the entry to bring up the "Properties" window. Click the "Driver" tab, and then click "Change Driver", or "Update Driver". Next a pop-up window with the message "Welcome to the Found New Hardware Wizard" will appear. Select "Install from a list or a specific location. (Advanced)". Click "Next". Select "Search for the best driver in these locations". Uncheck the box for: "Search removable storage media". Check the box for: "Include this location in the search". Enter path DRIVERS\WINXP within the chosen installation directory, such as C:\XCAP\DRIVERS\WINXP, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WINXP\EPIXXCW2.INF. Click "Next". A pop-up window will report that a "The software that you are installing ... has not passed compatibility testing". Click "Continue Anyway". A pop-up window with the message "Completing the Found New Hardware Wizard" will state that "The hardware you installed will not work until you restart your computer." Click "Finish" and reboot Windows.

6. Configure Graphics Display (S/VGA):

    a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the graphics display (S/VGA) is required for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is suggested for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Settings", "Control Panel", "Display", "Settings".

    b. Under "Start Button", "Setting", "Control Panel", "Display", "Appearance", "Effects", the "Use the following transition effect for menus and toolbars:", "Show shadows under menus", and "Show window contents while dragging" should all be disabled for maximum video performance.

7. Reboot Windows.

8. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.6. Windows XP Esoterica

3.6.1. Windows XP - Manual Installation

Use of EPIXXCW2.INF, above, provides automatic installation of EPIXXCW2.SYS in most circumstances. The following information allows manual installation, correcting problems, or

integration with an OEM's procedures.

1. The EPIXXCW2.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

   ```
   C:\WINNT\SYSTEM32\DRIVERS
   ```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2
   ```

   This entry must contain:

   ```
   ErrorControl  =  0x00000001
   Group         =  "Extended base"
   Start         =  0x00000001
   Type          =  0x00000001
   ```

   and may, as described below, also contain:

   ```
   PIXCI         =  "-IM <memorysize>"
   ```

   Create an entry such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW2
   ```

   This entry must contain:

   ```
   EventMessageFile = "%SystemRoot%\System32\IoLogMsg.dll"
   TypesSupported   = 0x00000007
   ```

3. Shut down and restart Windows.

3.6.2. Windows 2000/XP - Status Buffer Memory Allocation

Under Windows 2000/XP, memory to maintain status on each frame buffer must be allocated during Windows' initialization.

The requested memory size must be specified in the Registry entry described above, using an entry named "PIXCI", such as:

```
PIXCI         =  "-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in Kbytes. If no memory size is specified, a default size of 16 megabytes is used. Windows must be rebooted for the new specification to take effect.

For the PIXCI® CL3SD, which has on-board frame buffer memory, memory reserved by this parameter is needed only for support of time stamping of captured frames, such as optionally used by XCAP's Capture - Video to Frame Buffers. Currently, 64 bytes are needed for each frame buffer.

For systems which also use other PIXCI® imaging boards, the allocated memory is used for frame buffers; requesting a small amount of memory may limit the resolution which can be captured by other

PIXCI® imaging boards.

Windows 2000/XP limits the maximum amount of allocatable memory, dependent upon what other devices are installed, the total PC memory size, and other factors.

3.6.3. Windows 2000/XP - Authorization Key - Manual Installation

Use of HLDINST.EXE , as described above, provides automatic installation of the printer port authorization key's driver, needed under Windows 2000/XP, for XCAP-Plus, XCAP-Std, and XCAP-Ltd (but not needed for XCAP-Lite). The following information allows manual installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

   ```
   C:\WINNT\SYSTEM32\DRIVERS
   ```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock
   ```

   This key must contain values:

   ```
   ErrorControl  =  0x00000001
   Group         =  "Extended Base"
   Start         =  0x00000002
   Type          =  0x00000001
   ```

   or, if using REGEDT32, the values should appear as:

   ```
   ErrorControl:REG_DWORD:0x1
   Group:REG_SZ:ExtendedBase
   Start:REG_DWORD:0x2
   Type:REG_DWORD:0x1
   ```

3. Shut down and restart Windows for the new registry entries to take effect.

4. If the authorization key is connected to a non-standard printer port, an additional entry may be required:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock\Parameters
   ```

   which contains a value:

   ```
   IoPortAddress0  = 0x????            (for REGEDIT)
   IoPortAddress0:REG_DWORD:0x????     (for REGEDT32)
   ```

   where the "????" is replaced with the parallel port's I/O address in hexadecimal. As before, Windows must be shut down and restarted.

3.7. For Linux

XCAP requires Linux Kernel Version 2.4.8 or later. You must have super user privileges to complete the installation procedure.

1. Install Files:

    a. If XCAP is provided on a compact disk (CD):

        i. Assuming the CD has already been mounted, execute:

            ```
            /mnt/cdrom/XCAP/xcaplnx.bin
            ```

        ii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is `/usr/local/xcap`.

    b. If XCAP is provided via the internet:

        i. Download:

            ```
            ftp.epixinc.com/software/xcap_v22/xcaplnx.bin
            ```

            from the EPIX, Inc. ftp site.

        ii. Execute the downloaded program[4] from a shell prompt.

        iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is `/usr/local/xcap`.

        iv. Delete the downloaded `.bin` file from your PC's hard drive.

    c. The installation procedure creates a "stub" to start XCAP in one of the `/usr/local/bin`, `/usr/bin`, or `/bin` directories, which should already be in the user's execution "PATH". Several `.txt` files are installed under `help` in the installation directory containing these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The `pcitips.txt` file provides the *PC Configuration Tips*, with tips for resolving hardware and software conflicts.

2. Create Shortcut - Manual (optional):

    a. The procedure to create a shortcut on the desktop depends upon which of many rapidly evolving versions and distributions of Linux is used - most of which provide several choices for desktop managers. Consult your Linux documentation for specific procedures.

    b. The shortcut should execute `xcaplnx` in the XCAP installation directory, such as:

        ```
        /usr/local/xcap/xcaplnx
        ```

        if using the default installation directory.

    c. For shared, common XCAP settings and configuration, and shared default storage of

images, scripts and other data,[5] the shortcut should set the current working directory to the XCAP installation directory.

Alternately, XCAP will maintain individual settings and configuration, and individual default storage of images, scripts and other data, within the current working directory.

3. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

    a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

    The printer port authorization key is approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

    Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface which happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

    The USB port authorization key is approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port.

    The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

    b. The *Driver Assistant* within XCAP, provides interactive installation of the authorization key's driver(s).

4. Install PIXCI® Imaging Board Driver:

    a. The *Driver Assistant* within XCAP, provides interactive installation of the PIXCI® driver.

5. Configure Graphics Display (S/VGA):

    a. Configuring the graphics display (S/VGA) to TrueColor or DirectColor modes (using XWindows terminology), or to 24 or 32 bit modes (using S/VGA terminology) is suggested for higher quality, and quicker display of images and overlay graphics.

    Within XCAP, the current graphics display (S/VGA) configuration can be checked under *Utility*, *Linux Info*, *X11*.

6. XCAP is now ready to run, by executing "xcap", or by clicking the optional shortcut.

3.8. Linux Esoterica

3.8.1. Linux 2.4.x - Manual Installation

Use of the *Driver Assistant* within XCAP provides interactive installation of the `pixcii86.o` driver in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. Run

   ```
   insmod -o pixci [ --force ] pixcii86.o [ PIXCIPARM=<driver_config_parameters>
   ```

   using *--force* if trying to install the driver under a different kernel than it was intended, and using *PIXCIPARM=* to specify any optional Driver Configuration Parameters described below.

2. Run

   ```
   cat /proc/devices
   ```

   and note the major device number which is assigned to the `pixci` block device.

3. Run

   ```
   rm -f /dev/pixci
   mknod /dev/pixci c <major_number> 0
   chmod 666 /dev/pixci
   ```

4. For PIXCI® SV2, SV3, SV4, SV5, and SV5A imaging boards, other non-EPIX® drivers may have been installed during Linux's configuration. See *http://will.freehosting.net/bttv-HOWTO.html*, section 5.1 for information on removing the drivers. In brief, use

   ```
   lsmod
   ```

   to see the modules that are currently installed and if any of *videodev*, *i2c*, *i2c-char*, *tuner*, *msp3400* or *bttv* are listed, remove them in the order below using *rmmod*:

   ```
   rmmod bttv
   rmmod msp3400
   rmmod tuner
   rmmod i2c_chardev
   rmmod i2c-dev
   rmmod algo-bit
   rmmod i2c
   rmmod videodev
   ```

3.8.2. Linux 2.4.x - Status Buffer Memory Allocation

Under Linux, memory to maintain status on each frame buffer must be allocated during Windows' initialization.

The requested frame buffer memory size must be specified in the Driver Configuration Parameters, described above, using parameter

```
"-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in Kbytes. If no frame buffer memory size is specified, a default size of 4 megabytes is used.

For the PIXCI® CL3SD, which has on-board frame buffer memory, memory reserved by this parameter is needed only for support of time stamping of captured frames, such as optionally used by by XCAP's Capture - Video to Frame Buffers. Currently, 64 bytes are needed for each frame buffer.

For systems which also use other PIXCI® imaging boards, the allocated memory is used for frame buffers; requesting a small amount of memory may limit the resolution which can be captured by other PIXCI® imaging boards.

Linux limits the maximum amount of allocatable memory, dependent upon what other devices are installed, the total PC memory size, and other factors.

3.8.3. Linux 2.4.x - - Authorization Key - Manual Installation

Use of the *Driver Assistant* within XCAP, provides interactive installation of the authorization key's driver(s). For manual installation, correcting problems, or integration with an OEM's procedures installation instructions are provided in text file `hardlock/INSTALL` within the XCAP installation directory.

---

4. Getting Started with XCAP

This chapter will guide the user through the initial steps common to most applications using the PIXCI® imaging board: capturing, viewing, examining, and saving images. This guide isn't intended to discuss every feature of every window in XCAP, just the most important features to "get up and running".

By following the previous instructions, at this point:

a. The PIXCI® imaging board has been installed.

b. The camera has been connected to the PIXCI® imaging board.

c. The XCAP software has been installed.

d. For XCAP-Plus, XCAP-Std, or XCAP-Ltd, but not XCAP-Lite, the authorization key has been installed on the printer port, or a USB port.

e. Under Windows, the graphics display (S/VGA) has been set for 16 bits (minimum required), or 24 or 32 bits (preferred), per pixel. Under Linux, the graphics display has been set to DirectColor or TrueColor.

f. The PIXCI® driver for current version of Windows has been installed.

g. The PC has been rebooted (Ctrl+Alt+Del) so that the installed driver and the modified graphics display (S/VGA) settings (if any) have taken effect.

The following instructions are intended to be used while operating the PC; pictures of the graphics

display (S/VGA) are intentionally not shown, in favor of focusing the reader's attention on the actual graphics display's (S/VGA) screen.

4.1. Start XCAP

Under Windows, start XCAP by clicking:

```
Start (on the Windows Taskbar)
XCAP Imaging
```

and then clicking:

```
XCAP for Windows
```

Under Linux, start XCAP by executing:

```
xcap
```

The XCAP Main Window now appears.

4.2. Open PIXCI® Imaging Board

In the XCAP Main Window, click:

```
PIXCI®
PIXCI® Open/Close
```

A pop-up window appears.

Clicking:

```
Open
```

opens the PIXCI® imaging board for use, removes the Open/Close pop-up window, creates a PIXCI® Image Viewer window showing the first PIXCI® frame buffer, creates an Adjust window with commonly used camera specific and video capture adjustments, and creates a Shortcuts Toolbar for accessing the most commonly needed features.

The following windows are now active:

1. The Main Window, which has options for reconfiguring the PIXCI® imaging board, and features independent of the PIXCI® imaging board, such as loading images into image buffers unrelated to video capture hardware.

2. The PIXCI® Image Viewer window, from which the PIXCI® frame buffers are captured, viewed, examined, processed, measured, and saved, with a status bar below the image where cursor coordinates and other information is displayed.

3. The PIXCI® Shortcut Toolbar, with shortcuts for the most commonly needed features relating to the PIXCI® imaging board and its frame buffers.

4. An Adjust window, with commonly used camera specific and video capture adjustments.

If XCAP has already been installed, it may have been configured with one or more variations, such as, (a) Eliminate the Main Window, automatically opening and displaying the PIXCI® Image Viewer, (b) Configure the Shortcuts and/or Adjust features to be attached to The PIXCI® Image Viewer window, rather than detached into their own windows, (c) Select whether the Shortcuts and/or Adjust features appear automatically, or only when

```
Capture
Adjustments
```

or

```
Capture
Shortcuts
```

are clicked, or (d) Remove the status bar, increasing the screen area available for image display. These variations allow custom configuration of XCAP, but don't affect the functionality of the Shortcuts or Adjustments features.

4.3. PIXCI® CL3SD Video Configuration

The PIXCI® CL3SD imaging boards are customized for a specific camera. XCAP identifies the specific PIXCI® CL3SD imaging board, and defaults to capturing full video resolution from the specific camera.

4.4. Capturing Images

Once the PIXCI® imaging board is opened for use, images may be captured from the PIXCI® Image Viewer, clicking:

```
Capture
Snap
```

or

```
Capture
Live
```

The *Snap* captures a single image into the current frame buffer, while *Live* continuously captures images into the current frame buffer, continuously updating the image shown on the graphics display (S/VGA).

The *Live* mode may be used to adjust the camera's focus, aperture, and position. The *Live* mode may be halted by clicking:

```
Capture
UnLive
```

A *Live* followed immediately by *Unlive* has the same effect as *Snap*.

If the current video resolution and frame buffer memory size allows more than one frame buffer, clicking:

```
Capture
Adjustments
```

provides the:

```
Current (Frame) Buffer:   0
```

which may be incremented or decremented at any time, whether in *Live* or *UnLive* mode. The window reached by clicking:

```
Capture
Adjustments
```

has convenient buttons that duplicate the *Snap*, *Live*, and *UnLive* features.

As three of the most commonly used operations, the *Snap*, *Live*, and *UnLive* are also available in the Shortcuts Toolbar, in the top row, at the fifth and sixth from the left. The Shortcuts also allow changing the current frame buffer; in the top row, the four icons at the left switch to the first frame buffer, the next frame buffer (e.g. current buffer +1), the previous frame buffer (e.g. current buffer -1), and the last frame buffer, respectively.

4.5. Examining Images

4.5.1. Altering How the Image is Displayed

The PIXCI® Image Viewer can be moved and resized, using standard Windows techniques (drag the window's title bar, drag the window's corner, etc). By default, the captured image is displayed with resizing, so that the entire image fits within the Image Viewer.

For many engineering applications, examination of individual pixel values is critically important. Resizing the image may "hide" defective pixels; resizing an image with interlace jitter may turn odd/even line striping into bars of striping.

To view the exact pixels, from the PIXCI® Image Viewer, click:

```
View
Display
Resize: None (Image Pixel = Display Pixel)
```

Each image pixel is now displayed as exactly one graphics display (S/VGA) pixel. Of course, depending upon the image resolution, graphics display (S/VGA) resolution, and window size, the entire image may not fit. If the image doesn't fit, then (a) Scroll bars appear, allowing the viewed portion of the image to be panned and scrolled throughout the entire image, and (b) Moving the mouse with right button held over the displayed image causes panning or scrolling (if there is more image to be seen in the direction the mouse is moving).

Note that when:

```
Resize: None (Image Pixel = Display Pixel)
```

is selected, the displayed image's aspect ratio may not appear correct; the aspect ratio can't be corrected

without some form of resizing or resampling!

4.5.2. Zoom

To magnify the image, from the PIXCI® Image Viewer, click:

```
View
Zoom, Pan, Scroll
Zoom On
```

The magnification factor can be adjusted with:

```
Zoom Ratio
```

When magnified, only a portion of the image is visible. As described above, the viewed portion may be panned and scrolled through the entire image with the scroll bars, or by moving the mouse over the image with right button held.

4.5.3. Numeric Pixel Values

To examine numeric values of pixels as a table, from the PIXCI® Image Viewer, click:

```
Examine
Pixel Peek
```

A table of pixel values for a portion of the image appears, showing pixel values in the neighborhood of the displayed X and Y coordinates. The portion of the image numerically displayed can be moved by using the scroll bars, or by entering new X and Y coordinates.

The portion of the image which is numerically displayed can also be moved interactively by clicking:

```
Coord<=>Cursor
```

A cursor now appears over the image window (the Pixel Peek window may have to be moved to the side so that both the pixel peek window and the image viewer window can be seen); clicking the mouse on the image viewer window moves the cursor to that position, and repositions the numerically displayed portion of the image to be centered at that position.

To examine pixel values as a two-dimensional graph, click:

```
Examine
Pixel Plot
```

and

```
Controls
Where
and Plot Row
or  Plot Column
```

A graph of pixel values for a line (column) of the image appears, showing pixel values along the line (column) at the displayed Y (X) coordinate. The line (column) of the image which is shown can be

moved interactively by clicking:

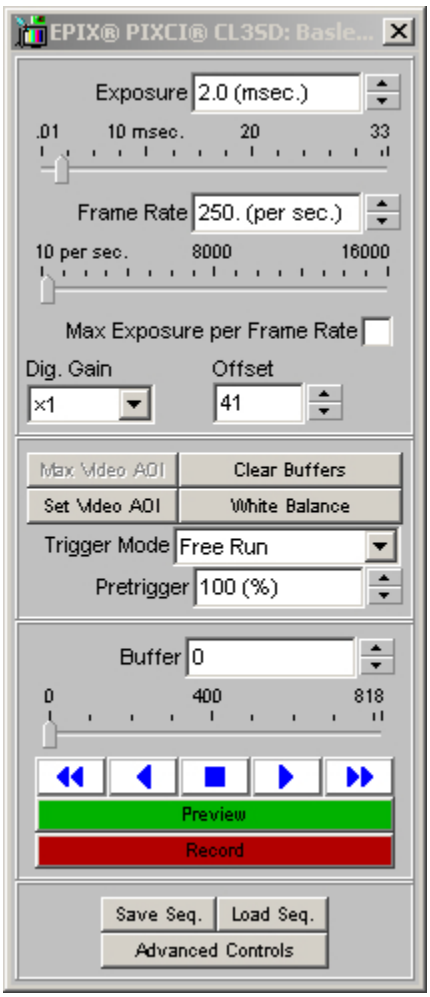
```
Coord<=>Cursor
```

A cursor now appears over the image window; clicking the mouse on the image window moves the cursor to that position, and repositions the displayed line (column) to that Y (X) coordinate.

4.6. PIXCI® CL3SD & Basler A500k Video & Camera Adjustments

XCAP provides two styles of camera and camera adjustments. The simpler style provides fewer, selected, integrated controls that is sufficient for many common applications. The advanced style provides all camera and PIXCI® CL3SD controls, but assumes more familiarity with the camera and PIXCI® CL3SD specifications and features.

4.6.1. PIXCI® CL3SD & Basler A500k Simple Video & Camera Adjustments



The *Preview/Live* button allows activating live video for focusing and exposure adjustments, or freezing live video capture, and duplicate the *Live*, and *UnLive* in the Shortcuts Toolbar.

The *Exposure* and *Frame Rate* allow adjusting the camera's exposure and frame rate; A faster *Frame Rate* and thus a shorter frame period automatically reduces the *Exposure*, as needed, to be no larger than the frame period. A slower *Frame Rate* and thus a longer frame period automatically adjusts the *Exposure* to the maximum permissible only if *Max Exposure per Frame Rate* is checked; some applications prefer the longest possible exposure for a given frame rate to increase sensitivity, other applications select a shorter exposure to help "freeze" motion.

The *Dig(ital) Gain* allows increasing the camera gain by multiplying each pixel's value by one, two, four, or eight. The *Offset* allows adjusting the camera's offset, or black level, so that black areas don't appear as grey; it is often needed in conjunction with *Dig(ital) Gain*.

The *Set Video AOI* button allows reducing the video resolution (the number of pixels captured per line and column) and allows capturing more video frames in a given size of frame buffer memory. Reducing the resolution also allows higher frame rates. After clicking *Set Video AOI*, draw the new desired area to be captured by right clicking and dragging over the displayed image. Click:

OK

to accept the new capture resolution. Note: Changing the capture resolution will destroy any previously captured images!

The *Max Video AOI* button restores the video resolution to the camera's maximum.

For color cameras, the *White Balance* button adjusts the white balance correction; the camera should be pointed at a white target before the button is clicked. Use of quality, non-reflective, non-fluorescent, white target is suggested, rather than a white piece of paper.

The *Clear Buffers* button sets all frame buffers to white.

The *Trigger Mode* allows selecting the desired sequence capture mode. In *Free Run*, sequence capture starts when the *Record* button is clicked. In *Continuous Run*, sequence capture starts when the *Record* button is clicked and runs continuously until the *Cancel* button (square icon) is clicked.

In *Ext. Start Event*, sequence capture is armed when the *Record* button is clicked and is started by the next trigger. The *Delayed Trigger* allows delaying the start of sequence capture after application of the trigger.

In *Ext. Stop Event*, sequence capture is armed when the *Record* button is clicked and is stopped by the next trigger. The *Pretrigger* allows delaying the termination of sequence capture after application of the trigger. A *Pretrigger* of 50% results in half of the captured images predating the trigger and half postdating the trigger.

In *Ext. Image Trigger* sequence capture is armed when the *Record* button is clicked and each image of the sequence captured upon application of the trigger.

All sequence capture modes can be prematurely terminated by the *Cancel* button (square icon).

After sequence capture, the *Play* button (right-arrow icon) allows playing the sequence forward, and

each click of the *Fast Play* button (double right-arrow icon) causes the play speed to increase. The *Reverse Play* button (left-arrow icon) allows playing the sequence reversed, and each click of the *Fast Reverse Play* button (double left-arrow icon) causes the reverse play speed to increase.

The *Cancel* button (square icon) stops play or reverse play. The *Buffer* numeric control shows the current buffer being displayed, and allows direct numeric entry of a desired buffer for display. Similarly, the *Buffer* slider indicates the approximate buffer being displayed, and allows manually scanning through the sequence and selecting a buffer.

The *Save Seq.* and *Load Seq.* allows saving and re-loading a captured sequence. These buttons are shortcuts to the

```
File
Save Image Sequence
```

and

```
File
Save Image Sequence
```

features.

Finally, the *Advanced Controls* allows switching to the advanced style camera controls.

4.6.2. PIXCI® CL3SD & Basler A500k Advanced Video & Camera Adjustments

When using the advanced controls, sequence capture is provided by a separate dialog:

```
Capture
Sequence Capture
Video to Frame Buffers
```

The *Alternate Controls* allows switching to the simpler style camera controls.

4.6.2.1. Video Resolution

Reducing the video resolution (the number of pixels captured per line and column) allows capturing more video frames in a given size of frame buffer memory. From the PIXCI® Image Viewer, click:

```
Capture
Adjustments
Res(olution)
```

Click:

```
Set Video Window
```

and draw the new desired area to be captured by right clicking and dragging over the displayed image. Click:

```
OK
```

to accept the new capture resolution. Note: Changing the capture resolution will destroy any previously captured images!

The

```
Capt(ure)
Frame Buffers
```

shows the number of frame buffers available with the current selections.

4.6.2.2. Saving the Video Configuration

The selections under the PIXCI® Image Viewer:

```
Adjustments
```

are automatically saved when the PIXCI® imaging board is closed, and/or XCAP is exited. When the PIXCI® imaging board is next opened (from the XCAP Main Window clicking):

```
PIXCI®
PIXCI® Open/Close
Camera & Format
```

You may choose:

```
Open w. last used Video Setup
```

to use the previous video setup, or choose:

```
Open w. default Video Setup
```

to start afresh with the default video format and resolution.

4.6.2.3. Camera Controls

XCAP integrates controls for both the PIXCI® imaging board and the camera within the Adjust window. The left side of the Adjust window contains controls for the PIXCI® imaging board. The right side of the Adjust window provides camera specific controls; these utilize the same concepts and terminology as specified by the camera's manufacturer, so that the camera manufacturer's documentation can be directly applied to these features and controls.

For cameras using a CameraLink interface, the serial commands are sent via the same CameraLink cable used for imagery. Any change of the camera's controls shown in the Adjust window simultaneously programs the camera and automatically sets the PIXCI® imaging board's configuration to match. There is no need to run the camera manufacturer's separate control program.

4.6.2.4. Color Cameras

For color cameras with so-called "Bayer format output", it is XCAP software which performs color adjustments and white balancing, not the camera. From the PIXCI® Image Viewer, click:

```
Capture
Adjustments
Color (or Clr)
```

For most common conditions:

a. Select a one of the pre-defined correlated color temperatures, either based on best appearance, or matching the color temperature of the current illumination. The *5000°K* selection is average overcast daylight, the *4100°K* selection is a typical cool white fluorescent bulb, and the *2800°K* selection is a typical 60 to 100 watt tungsten bulb.

b. Choose one of the predefined color qualities, trading quality for speed.

c. If none of the predefined settings is satisfactory, start with the best setting and click:

```
Customize
```

Cover the camera's lens and click:

```
Black Balance
```

Finally point the camera at white target (but preferably not a target using fluorescent brighteners) and click:

```
White Balance
```

4.7. Saving Images

To save an image, from the PIXCI® Image Viewer, click:

```
File
Save Image
```

Choose a file format, such as:

```
TIFF
JPEG/JFIF
BMP
FITS
PCX
Targa (TGA)
X/Y Binary
X/Y ASCII
```

TIFF is an industry standard, and the most commonly used image file format; TIFF is suggested for saving and reloading an image into XCAP, and suggested for exporting images to other programs which support TIFF. The JPEG/JFIF is also a commonly used image file format and can provide high, but lossy, compression. The FITS is a commonly used format within the scientific - particularly astronomy - community. The BMP, PCX, and TGA formats are useful when exporting an image into other programs that don't support TIFF; but these file formats support only 8 bits per pixel component (such as 8 bit monochrome or 24 bit RGB).

The X/Y Binary and X/Y ASCII export raw pixels, left to right, top to bottom, with no excess

information such as dimensions, bit depth, date, format, etc; these are useful for exporting images to a spreadsheet (X/Y ASCII), or to your own program that can assume the image's dimensions and can simply read a 2-D array of values.

After selecting a file format, enter a file name:

```
File Name:  xx.tif
```

and click

```
OK
```

to save the image. Or, use the:

```
Browse
```

button to access the standard Windows File Dialog, click

```
Accept
```

to accept the filename selected by browsing, and click

```
OK
```

to save the image.

4.8. Additional XCAP Documentation

For additional guidance in using XCAP, click

```
Help
XCAP Reference Manual
```

to browse the full manual.

---

5. Getting Started with XCLIB

The optional XCLIB C/C++ library allows controlling the PIXCI® imaging board from "C" and "C++" programs. Under Windows, the XCLIB library can also be accessed by any programming environment able to call functions within a DLL; a partial list includes Visual Basic, LabView, and Borland Delphi.

The XCLIB library is designed to be a component which is called by the user's application, rather than an application template with preselected and limited customizability. In other words, the XCLIB library forces the fewest possible architectural choices upon the user's application. Under Windows the XCLIB library is composed of "C" functions within a DLL and can be used from non-MFC, MFC, C#, or even "console" applications. With one optional exception, the XCLIB library does not create any windows or dialogs of its own; rather it allows displaying imagery into any window provided by the user.

This quick introduction focuses primarily on XCLIB functions themselves; programming environment, operating system issues, and compilation instructions are addressed in the *XCLIB Reference Manual* and in the example programs provided with XCLIB. Nor is this introduction intended to cover every XCLIB function or to provide complete programs; rather it is intended to provide the "feel" of XCLIB programming, without the complications of user interfaces and application specific functionality.

5.1. XCLIB Architecture Overview

The XCLIB has two series of functions. The Simple C Functions (SCF), whose names start with *pxd_*, suffice for most programs using one imaging board, or multiple imaging boards of the same type and operating at the same resolution. This introduction only discusses the SCF functions.

Frame buffers are selected by ordinals 1, 2, etc. The number of frame buffers is dependent on the camera resolution and the amount of on-board memory.

For cameras with raw Bayer output, XCLIB automatically provides processed RGB pixel values.

Functions to snap a video field (such as *pxd_goSnap*, discussed below) capture the next video field following its invocation. In other words, the function "arms" the PIXCI imaging board to capture the next video field into a frame buffer. This is in contrast to having the imaging board consume resources continuously capturing everything, and having a hypothetical snap function retrieve the last field captured. This hypothetical behaviour can be obtained in XCLIB using *pxd_goLivePair* (also discussed below) or similar functions, but it isn't the behaviour of the snap function.

5.2. The Simplest XCLIB Program

The following code captures an image into the first frame buffer with the imaging board and camera in the default mode:

```
#include "xcliball.h"
    ...
pxd_PIXCIopen(NULL,         // driver configuration parameters: use default
              "Default",    // video format name: use default as per specific
              NULL);        // video setup file exported by XCAP: none
pxd_doSnap(0x1,             // select PIXCI unit 1
           1,               // select frame buffer 1
           0);              // default timeout
pxd_PIXCIclose();
```

For a shorter program, under Windows and Linux (but not DOS) the:

```
pxd_PIXCIclose();
```

may be eliminated, but for the sake of robustness and portability including the *pxd_PIXCIclose* is strongly recommended.

A slightly longer program that does something useful with the captured image:

```
#include "xcliball.h"
    ...
```

```
pxd_PIXCIopen(NULL, "Default",  NULL);
pxd_doSnap(0x1, 1, 0);
pxd_saveTiff(0x1,           // select PIXCI unit 1
             "image.tif",   // pathname
             1,             // select frame buffer 1
             0, 0,          // upper left X, Y AOI of buffer
             -1, -1,        // lower right X, Y AOI of buffer,
                            // -1 is an abreviation for the maximum X or Y
             0, 0);         // reserved
pxd_PIXCIclose();
```

which saves the captured image to a file, or:

```
#include "xcliball.h"
    ...
pxd_PIXCIopen(NULL, "Default",  NULL);
pxd_doSnap(0x1, 1, 0);
{
    void *buf = malloc(  pxd_imageXdim()    // horizontal resolution
                       * pxd_imageYdim()    // vertical resolution
                       * sizeof(short));

    pxd_readushort(0x1,         // select PIXCI unit 1
                   1,           // select frame buffer 1
                   0, 0,        // upper left X, Y AOI of buffer
                   -1, -1,      // lower right X, Y AOI of buffer,
                                // -1 is an abreviation for the maximum X or Y
                   buf,         // program buffer to be filled
                   pxd_imageXdim() * pxd_imageYdim(),
                                // size of program buffer in short's
                   "Grey");     // color space to access
    .. process data ..
    free(buf);
}
pxd_PIXCIclose();
```

which copies the captured image into a program buffer. Both *pxd_saveTiff* and *pxd_readushort* allow saving or reading from an area of interest (AOI) of the captured image.

The XCLIB provides data conversions, "unsigned char" versus "unsigned short", as necessary, as well as color space conversions. Thus, *pxd_readushort* will work with 8, 10, or 12 bit pixels, enlarging 8 bit pixels to unsigned shorts (right justified). And the similar *pxd_readuchar* also works with 8, 10, or 12 bit pixels, truncating 10 or 12 bit pixels to unsigned chars (keeping the most significant bits).

Similarly, these functions convert color spaces as needed; in the example above, correct grey level data is provided regardless of whether the captured image is monochrome, RGB, BGR, or Bayer.

For resolution and color space dependent access to pixel data the pixel size, resolution and color space can be queried:

```
..
pxd_doSnap(0x1, 1, 0);
{
    void *buf = malloc(  pxd_imageXdim()    // horizontal resolution
                       * pxd_imageYdim()    // vertical resolution
                       * (pxd_imageBdim()>8? sizeof(short): sizeof(char))
                                            // bit depth
                       * pxd_imageCdim());  // number of color components
```

```
    if (pxd_imageBdim() <= 8)
        pxd_readuchar(0x1, 1, 0, 0, -1, -1, buf,
                      pxd_imageXdim() * pxd_imageYdim() * pxd_imageCdim(),
                      pxd_imageCdim()==1? "Grey": "RGB");
    else
        pxd_readushort(0x1, 1, 0, 0, -1, -1, buf,
                      pxd_imageXdim() * pxd_imageYdim() * pxd_imageCdim(),
                      pxd_imageCdim()==1? "Grey": "RGB");
    .. process data ..
    free(buf);
}
```

In practice, most application programs are designed for a specific camera and resolution, and the above code can be simplified by using only the relevant *pxd_readuchar* or *pxd_readushort*.

Note that for Bayer output cameras, the *pxd_imageCdim()* is the number of effective and useful colors, namely 3, not the number of raw values per pixel!

5.3. XCLIB Error Detection

Every real application should check for errors. Most XCLIB functions return an integer value, with values less than 0 indicating an error. The *pxd_mesgErrorCode* function provides a textual description for each error:

```
int     r;
r = pxd_saveTiff(0x1, "image.tif", 1, 0, 0, -1, -1, 0, 0);
if (r < 0) {
    // For Windows GUI
    MessageBox(NULL, pxd_mesgErrorCode(r)), "XCLIB Error", MB_OK|MB_TASKMODAL)
    // For Windows Console, DOS, Linux
    printf("XCLIB Error: %s\n", pxd_mesgErrorCode(r));
}
```

In addition, the *pxd_mesgFault* provides a detailed report for errors occurring during *pxd_PIXCIopen* and video capture functions.

```
int     r;
r = pxd_PIXCIopen(NULL, "Default", NULL);
if (r < 0)
    pxd_mesgFault(0x1); // select PIXCI unit 1
```

Under Windows, the *pxd_mesgFault* pops up a dialog. Under DOS or Linux it displays error information to "stderr".

Hereafter, for the sake of brevity and clarity, error checking will not be shown.

5.4. PIXCI® CL3SD Video Configuration

The PIXCI® CL3SD video setup defaults to match the camera's default configuration: full resolution, free-run.

To change the video setup, such as to select EXSYNC trigger mode, or to reduce resolution so as to obtain more frame buffers within a given amount of memory:

a. Using XCAP, configure the desired format and resolution.

b. Use:

```
PIXCI
PIXCI Save Video Setup
```

to save the video setup to a specified file name.

c. Use:

```
pxd_PIXCIopen(NULL, NULL, path_to_file_name);
```

to open XCLIB with the same video setup. The third parameter can be a fully qualified path name or a file name; if the latter, the standard operating system default determines what directory (folder) is expected to contain the file name.

Alternately, the *pxd_videoFormatAsIncluded* allow switching the video setup without re-opening XCLIB, as well as compiling the video setup file into the application. See the *XCLIB Reference Manual* for more information.

Neither of the above methods re-configures the camera via its RS-232-like Camera Link serial commands. The camera's default configuration can be changed using the manufacturer's software. Alternately, an application note in the *XCLIB Reference Manual* describes how to use serial commands to re-configure the camera via XCLIB. In either case, it is important that the camera's configuration, such as trigger mode versus free-run mode, match the PIXCI® imaging board's configuration.

5.5. PIXCI® CL3SD Video Configuration

The PIXCI® CL3SD video setup defaults to match the camera's default configuration - that is full resolution, free-running.

To change the video setup, such as to select Exsync trigger mode, or to reduce resolution so as to obtain more frame buffers within a given amount of memory:

a. Using XCAP, configure the desired format and resolution.

b. Use:

```
PIXCI
PIXCI Save Video Setup
```

to save the video setup to a specified file name.

c. Use:

```
pxd_PIXCIopen(NULL, NULL, path_to_file_name);
```

to open XCLIB with the same video setup. The third parameter can be a fully qualified path name or a file name; if the latter, the standard operating system default determines what

directory (folder) is expected to contain the file name.

Alternately, the *pxd_videoFormatAsIncluded* allow switching the video setup without re-opening XCLIB, as well as compiling the video setup file into the application. See the *XCLIB Reference Manual* for more information.

The camera is configured via RS-232-like Camera Link serial commands; neither of the above methods re-configures the camera via its serial commands. The camera's default configuration can be changed using the manufacturer's software. Alternately, an application note in the *XCLIB Reference Manual* describes how to use serial commands to re-configure the camera via XCLIB. In either case, it is important that the camera's configuration, such as trigger mode versus free-run mode, match the PIXCI® imaging board's configuration.

5.6. More Video Capture Modes

The:

```
pxd_doSnap(...);
```

is the easiest function for capturing single images; the programmer specifies the buffer and the function returns when the capture is completed.

Other capture functions return immediately, allowing the application to proceed with other tasks without having to utilize multiple execution threads. The:

```
pzd_goSnap(0x1, // select PIXCI unit 1
           1);  // select frame buffer 1
```

initiates capture of a single video field into the specified buffer, the:

```
pzd_goLive(0x1, // select PIXCI unit 1
           1);  // select frame buffer 1
```

initiates continuous capture of each video field into the specified buffer, the:

```
pxd_goLivePair(0x1, // select PIXCI unit 1
               1,   // select frame buffer 1
               2);  // select frame buffer 2
```

initiates continuous captured of each video field into alternate buffers, the:

```
pxd_goLiveSeq(0x1   // select PIXCI unit 1
              1,    // select start frame buffer 1
              10,   // select end frame buffer 2
              1,    // incrementing by one buffer
              10,   // for a total of ten frames
              1);   // advancing to the next buffer after each frame
```

initiates capture at video rate of ten fields into ten buffers, and finally the:

```
pxd_goLiveSeq(0x1               // select PIXCI unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
```

```
                    1,                  // incrementing by one buffer
                    0,                  // for ever
                    1);                 // advancing to next buffer after each 1 frame
```

initiates continuous capturing of video fields at video rate into a "ring" composed of all frame buffers.

For use along with capture functions that run in the "background" are functions to monitor their progress. For example:

```
pxd_goSnap(0x1, 1);
for (;;) {
    if (!pxd_goneLive(0x1, 0))
        break;
    .. do some useful work while waiting..
}
```

is one method of checking whether the previous *pxd_goSnap* is done. Or,

```
pxbuffer_t  last = -1;

pxd_goLivePair(0x1, 1, 2);
for (;;) {
    if (pxd_capturedBuffer(0x1) == last)
        continue;   // nothing new captured yet
    last = pxd_capturedBuffer(0x1);
    .. process last captured image ..
}
```

continuously captures into a pair of buffers, processing each video field as the next is being captured.

Of course, many applications prefer to avoid "polling" for status within a loop. The XCLIB also provides asynchronous notification of both,

a. A field has arrived from the camera (whether XCLIB was instructed to capture it or not),

b. A field has been captured.

In Windows these notifications take the form of an "Event", in DOS these notifications take the form of a callback function, and in Linux these notifications take the form of a "signal". For example, under Windows:

```
HANDLE event = pxd_eventCapturedFieldCreate(0x1);   // select PIXCI unit 1
```

Thereafter, any thread waiting upon the event will be notified whenever a field has been captured by *pxd_goSnap*, *pxd_goLive*, *pxd_goLivePair*, *pxd_goLiveSeq*, or by the *pxd_goLiveTrig* discussed below.

5.7. PIXCI® CL3SD Triggered Capture

Cameras used with the PIXCI® CL3SD have a free-run mode; continuously exposing and sending video to the imaging board. They also have an asynchronous trigger mode; where the camera exposure and video is quiescent until arrival of a trigger, upon which the sensor is exposed once and a single image sent to the imaging board.

When combined with the capabilities of the PIXCI® imaging board, the camera may be in asynchronous trigger mode but with the imaging board generating periodic triggers (in XCAP this is governed by the *Controlled Frame Rate*). For the purposes of this discussion on XCLIB triggered capture, this combination is effectively the same as if the camera were in a free-run mode.

5.7.1. Free-Run Trigger Capture

For a camera and imaging board combination in free-run mode, triggering consists of selecting a field or frame to capture.

A simple trigger example using the general purpose level sensitive input, is:

```
int odata;
odata = pxd_getGPIn(0x1,    // select PIXCI unit 1
                    0);     // reserved
while (odata == pxd_getGPIn(0x1, 0))
    ;
pxd_doSnap(0x1, 1, 0);
```

which waits until any of the general purpose input(s) have changed, then snaps the next field or frame arriving from the camera.

Or,

```
int odata = pxd_getGPIn(0x1, 0);    // save current G.P inputs
pxd_goLive(0x1, 1);                 // capture continuously
pxd_setGPout(0x1, 0x01);            // set output flag that we are ready
while (odata == pxd_getGPIn(0x1, 0))
    ;                               // wait for trigger
pxd_setGPout(0x1, 0x00);            // set output flag that we saw the trigger
pxd_goUnLive(0x1);                  // terminate continuous capture
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
pxd_setGPout(0x1, 0x01);            // set output flag that we are done
```

This variation captures the field or frame which was being sent while the trigger was received; the former example captures the field or frame following the trigger. It also demonstrates use of the general purpose output for "handshaking" with the external equipment.

Both of these examples depend on the application responding to the general purpose input in a timely manner, and both consume time in wait loops. Neither is a significant problem under single-tasking DOS, but can be a problem under multi-tasking Windows or Linux depending upon how much latency the application allows and what other tasks are running.

Alternately, the *pxd_goLiveTrig* described in the *XCLIB Reference Manual* performs the same function as the latter example including use of general purpose output "strobes", but returns immediately leaving the trigger capture running in the "background". It also provides minimal latency and additional options for delaying the capture following the trigger by a specified number of fields or frames.

Triggering can also be done using the general purpose edge sensitive trigger:

```
int ocnt = pxd_getGPTrigger(0x1, 0);        // save current trigger count
while (ocnt == pxd_getGPTrigger(0x1, 0))    // wait for change
```

```
    ;
pxd_doSnap(0x1, 1, 0);                          // snap
```

or

```
int ocnt = pxd_getGPTrigger(0x1, 0);        // save current trigger count
pxd_goLive(0x1, 1);                         // capture continuously
while (ocnt == pxd_getGPTrigger(0x1, 0))    // wait for change
    ;
pxd_goUnLive(0x1);                          // terminate continuous capture
while pxd_goneLive(0x1, 0))                 // wait for capture to cease
    ;
```

For applications which prefer to avoid "polling" for status within a loop, XCLIB also provides asynchronous notification of the general purpose trigger. As for video field notifications, in Windows these notifications take the form of an "Event", in DOS these notifications take the form of a callback function, and in Linux these notifications take the form of a "signal". For example, under Windows:

```
HANDLE event = pxd_eventGPTriggerCreate(0x1, 0, 0);   // select PIXCI unit 1
```

Thereafter, any thread waiting upon the event will be notified upon the general purpose trigger, and can then do a *pxd_goSnap* or *pxd_goUnLive*, as appropriate.

5.7.2. Asynchronous Trigger Capture

For a camera in asynchronous trigger mode, there are two possible submodes. In one submode, the trigger is external. An example of capturing a single triggered image is:

```
pxd_goSnap(0x1, 1);             // call BEFORE trigger is expected
while pxd_goneLive(0x1, 0))     // wait for trigger then
    ;                           // wait for capture to cease
```

The pxd_doSnap should not be used, unless its *timeout* parameter adjusted to accommodate the delay before the trigger arrives. The *pxd_goLive*, *pxd_goLivePair*, and *pxd_goLiveSeq* can also be used to continuously capture triggered images, or to capture a sequence of triggered images. Neither *pxd_getGPTrigger* nor its asynchronous notification (e.g. *pxd_eventGPTriggerCreate*) need be used.

In the second submode, the PIXCI® imaging board automatically issues a single trigger pulse (in XCAP this is described as the "Button" or "Snap Button" trigger selection.) In XCLIB, the equivalent is simply:

```
pxd_doSnap(0x01, 1);
```

or

```
pxd_goSnap(0x01, 1, 0);
```

which both "arm" the PIXCI® imaging board to capture an image and trigger the camera. Neither *pxd_getGPTrigger* nor its asynchronous notification (e.g. *pxd_eventGPTriggerCreate*) need be used. The *pxd_goLive*, *pxd_goLivePair*, and *pxd_goLiveSeq* are not appropriate for this mode.

5.8. PIXCI® CL3SD Triggered Sequence Capture

For a camera and imaging board combination in free-run mode, triggering consists of selecting a field or frame on which to start or end capture. For example:

```
int odata;
odata = pxd_getGPIn(0x1,    // select PIXCI unit 1
                    0);     // reserved
while (odata == pxd_getGPIn(0x1, 0))
    ;
pxd_goLiveSeq(0x1               // select PIXCI unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              pxd_imageZdim(),  // for this many captures
              1);               // advancing to next buffer after each 1 frame
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
```

which waits until any of the general purpose inputs have changed, then fills the frame buffers with at video rate.

Or,

```
int ocnt = pxd_getGPTrigger(0x1, 0);
pxd_goLiveSeq(0x1               // select PIXCI unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              0,                // for ever
              1);               // advancing to next buffer after each 1 frame
while (ocnt == pxd_getGPTrigger(0x1, 0))
    ;
pxd_goUnlive(0x1);
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
printf("Most recent captured buffer: %d\n", pxd_capturedBuffer(0x1);
```

which continuously captures until the general purpose trigger arrives, leaving the frame buffers filled with video fields or frames that predate the trigger.

Or,

```
int     odata = pxd_getGPIn(0x1, 0);
ulong   fieldcount;
pxd_goLiveSeq(0x1               // select PIXCI unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              0,                // for ever
              1);               // advancing to next buffer after each 1 frame
while (odata == pxd_getGPIn(0x1, 0))
    ;
fieldcount = pxd_getFieldCount(0x1);    // get current value of field counter
while (pxd_getFieldCount(0x1) < fieldcount+(pxd_imageZdim()/2)*pxd_imageIdim()
    ;
pxd_goUnlive(0x1);
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
printf("Most recent captured buffer: %d\n", pxd_capturedBuffer(0x1);
```

which continuously captures until the trigger arrives, waits for half of the frame buffers to be filled following the trigger, then terminates capture. The captured result is half of the frame buffers predate the trigger and half postdate the trigger.

As for single image trigger capture, polling on the *pxd_getGPTrigger* can be avoided by using asynchronous notifications (e.g. *pxd_eventGPTriggerCreate*). Alternately, the *pxd_goLiveSeqTrig* described in the *XCLIB Reference Manual* performs the same function as the last three examples, but returns immediately leaving the trigger capture running in the "background" and provides minimal latency.

For a camera in asynchronous trigger mode, with an external trigger, sequence capture is simply:

```
pxd_goLiveSeq(0x1               // select PIXCI unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              pxd_imageZdim(),  // for this many captures
              1);               // advancing to next buffer after each 1 frame
while pxd_goneLive(0x1, 0))     // wait for capture to cease
    ;
```

In the second trigger submode, where the PIXCI® imaging board automatically issues a single trigger pulse (in XCAP this is described as the "Button" or "Snap Button" trigger selection), sequence capture is simply:

```
int     i;
for (i = 1; i <= pxd_imageZdim(); i++) {
    pxd_goSnap(0x1, i);
    while pxd_goneLive(0x1, 0))         // wait for capture to cease
        ;
}
```

As before, the polling can be avoided by using asynchronous event notifications.

5.9. Additional XCLIB Documentation

For additional guidance in using XCLIB, consult the *XCLIB Reference Manual* and the example programs provided with XCLIB.

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6. XCAP Software Guide

XCAP is a family of sophisticated, interactive, imaging programs specifically designed to support the PIXCI series of imaging boards, but also able to process and analyze images from other imaging sources. Several versions of XCAP are available: XCAP-Plus, XCAP-Std, XCAP-Ltd, XCAP-Lite, and XCAP-Demo. All versions share the same user interface and menu structure, but selected features in XCAP-Std, XCAP-Ltd, XCAP-Lite, and XCAP-Demo are not operational. XCAP is distributed on CD, diskette(s), or downloadable from the EPIX, Inc. website. After installation, a 12 character identification code[6] is entered to configure XCAP as either XCAP-Plus, XCAP-Std, XCAP-Ltd,[7] or XCAP-Lite; or, lacking a valid code, configured as XCAP-Demo to browse, but not use, XCAP's features.

XCAP-Std is an interactive, imaging program designed for scientific, industrial, and machine vision applications. XCAP-Std supports the PIXCI imaging board, providing video format and resolution configuration; continuous (live), video rate sequence, and triggered capture; and single or sequence, zoomed or resized, display. The image frame buffers of PIXCI imaging boards can be loaded, examined, processed, analyzed, measured, printed, annotated, and saved.

XCAP-Std also allows loading, analyzing, modifying, and saving a pre-existing image or image sequence with size, pixel depth, and color space independent of the PIXCI imaging board's configuration; XCAP-Std can be used with pre-existing images even when the PIXCI imaging board is not present. XCAP-Std can also acquire images from TWAIN compliant devices.

XCAP-Plus provides extra, advanced, features in addition to all of the capabilities of the XCAP-Std, such as support for specialized, optional, hardware.

XCAP-Ltd is a simplified version of XCAP-Std. XCAP-Ltd provides the same image acquisition and PIXCI imaging board control capabilities, the same image display features, and the same image loading, examining, printing, and saving of single image or sequences of images. Only minimal image processing, measurement, analysis, and scripting features are functional. XCAP-Ltd can be used with pre-existing images even when the PIXCI imaging board is not present.

XCAP-Lite is a much simplified version of XCAP-Std. XCAP-Lite provides similar image acquisition and PIXCI imaging board control capabilities, video format and resolution configuration; continuous (live), video rate sequence, and triggered capture; and single or sequence, zoomed or resized, display. XCAP-Lite also provides some of the image loading, examining, printing, and saving features, but minimal processing, measurement, analysis, and scripting features are functional. XCAP-Lite can also be used with pre-existing images, but only while the PIXCI imaging board is present and opened for use.

XCAP-Demo allows browsing through the dozens of processing, measurement, analysis, and graphics features provided in XCAP-Plus, XCAP-Std, or XCAP-Lite. Images can't be loaded from, or saved to, files. Nor can the PIXCI imaging board be operated with the XCAP-Demo version.

As XCAP-Plus, XCAP-Std, XCAP-Ltd, and XCAP-Lite share many common features, this manual typically refers to all versions as XCAP, except where explicitly differentiated.

The XCAP features are organized into two major types of windows, the Main Window and one or more Image Viewer Windows.

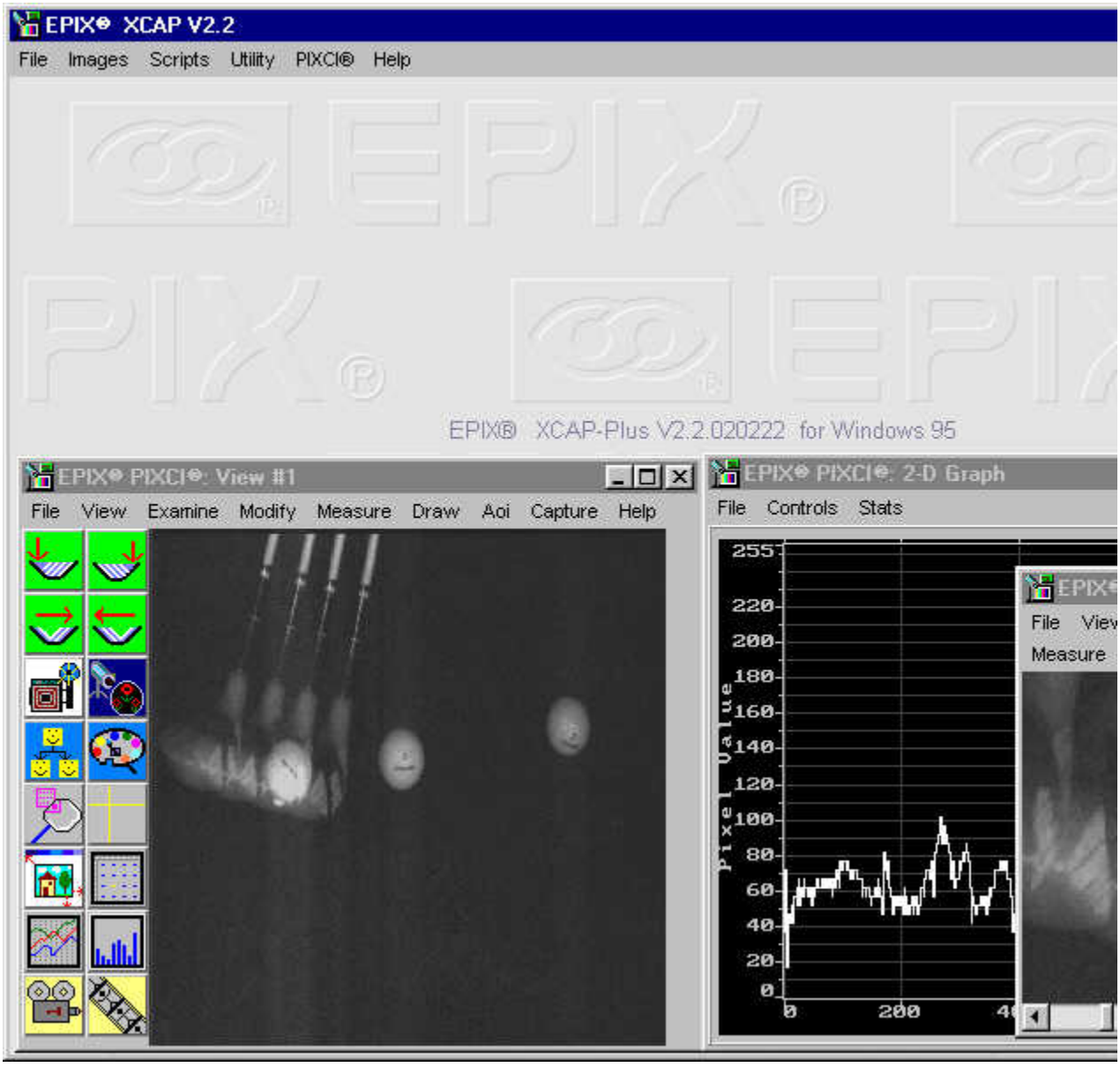
For each image, or sequence of images, an Image Viewer Window shows that image, or a selected image of that sequence, and via its menu bar allows viewing, examining, processing, analyzing, or drawing upon that image (sequence). The Image Viewer Window associated with the PIXCI imaging board's frame buffers also provides features for capturing new images. There can be multiple Image Viewer Windows for the same image (sequence), allowing, for example, viewing the image both zoomed and unzoomed, or simultaneous viewing of different images of a sequence.

The Main Window allows creating new image (sequences), and thus new Image Viewer Windows, either by loading a new image from file, explicit specification of the new image's dimensions, or by opening the PIXCI imaging board for use. Video setup for the PIXCI imaging

board, such as modifying the video resolution or color space, are also in the Main Window; these features may destroy and re-create the PIXCI imaging board's Image Viewer Window. The Main Window also provides features not directly associated with an image (sequence), such as scripts, RS-232 device control, and features to customize XCAP.

6.1. The Main Window

The XCAP main window provides a menu bar with *File*, *Images*, *Scripts*, *Utility*, *PIXCI®*, and *Help* features.



6.1.1. Main Window - File

The main window's *File* allows loading of pre-existing images into new image buffers, displaying attributes about pre-existing images, and acquiring images from TWAIN compliant devices.

The *Load New Image* and *Load New Image Sequence* creates a new image buffer (sequence) with dimensions, pixel depth, and color space matching a specified TIFF, BMP, JPEG, FITS, or multimedia format file(s), and loads the image(s) from the file(s). This feature, and the image buffer (sequence) created, is unrelated to the PIXCI imaging board's frame buffers. After creation and loading, the new image (sequence) is displayed, processed, and analyzed in The Image Viewer Window, described below. The *Load New Image* can also load images directly from an Internet URL. The XCAP-Lite version does not provide the *Load New Image Sequence* or loading directly from an URL features.

The *Image File Info* displays information about a specified TIFF, BMP, JPEG, or FITS format file without loading the image. The information displayed includes the image's dimensions, pixel depth, color space, palette option, and other file format specific information.

The *TWAIN Select Source* and *TWAIN New Acquire* allow using XCAP as a TWAIN Application, acquiring images from TWAIN compliant imaging devices (TWAIN Sources). The *TWAIN Select Source* allows selecting which TWAIN Source is to be used, and the *TWAIN New Acquire* allows acquiring one image from the TWAIN Source. The XCAP-Lite and XCAP-Ltd versions do not support being used as a TWAIN Application.

The *Window List* displays a list of active windows belonging to XCAP; selecting a window causes that window to appear, if previously hidden, and/or to appear over other windows (subject to the priority of selected windows to always appear "on top").

6.1.2. Main Window - Images

The main window's *Images* allows creating new image buffers and activating any existing image windows that may not be on-screen.

The *New Image* creates a new image buffer, or sequence of image buffers, with specified dimensions, pixel depth, color space, and palette. This feature, and the image buffer created, is unrelated to the PIXCI imaging board's frame buffers. After creation, the new image is displayed in an The Image Viewer Window, as described below.

Underneath *New Image* are listed all existing image windows, whether for PIXCI imaging board frame buffers, or for independent image buffers. (The image window for PIXCI imaging board frame buffers appears only after the PIXCI imaging board has been opened for use, see below). An image window which has been closed and thereby off-screen can be reactivated by clicking the image window's name.

6.1.3. Main Window - Scripts

The main window's *Scripts* provides features for recording and playing scripts. A script recording contains most of the user's interactions with the windows of XCAP; playing the script duplicates the original actions.

Some user actions are not recorded. Using the mouse to drag the cursor or other graphic across an image is not recorded as these actions are highly dependent upon image content (such as the typical scenario of dragging the cursor until it is positioned next to an artifact in a captured image), would likely be inappropriate to other captured images, and would consume a significant amount of disk space. Instead, after positioning the cursor interactively the user can record the

final position by clicking the appropriate numeric cursor coordinates. Features activated with keys, or clicking icons are not currently recorded; such features can also activated by other means, that are recorded.

A recorded script is in a human readable form and can be altered with any common editor capable of handling ASCII text, allowing scripts to be modified or combined. A selected script may be executed automatically after XCAP starts, this feature is set in *Utility*, *Program Setup*, *Startup Script*.

The *Load Tool Bar* provides one or more user-defined tool bars of shortcuts, each shortcut represented by an icon which, when clicked, executes a user-specified script. Each shortcut may also specify an optional keyboard key which, when pressed, also executes the user-specified script.

The *Script Remote Control* allows using XCAP as a hidden, off-screen, "black box"; any end-user application that can manipulate text files, can also remotely control XCAP.

The XCAP-Lite and XCAP-Ltd versions do not support recording scripts, creating user-defined tool bars, or the remote control feature. The XCAP-Lite and XCAP-Ltd versions can play scripts previously created with XCAP.

6.1.4. Main Window - Utility

The main window's *Utility* provides an assortment of features that are of secondary importance; features that allow fine tuning of XCAP, or features needed in relatively few circumstances.

The *Black Board* allows customizing XCAP, creating non-procedural programs, and collecting data. The black board allows inter-connecting the numeric and text field of other windows; computed results, such as center-of-mass, may be written onto the black board - parameters for other features, such as the coordinates of a displayed grid, may be extracted from the black board - combining these automatically repositions the grid as the center of mass is recomputed! Other features allow computed values (similar to a spreadsheet), "push"ing buttons, timed updates, creating a report to file or an RS-232 port, collecting data, and graphing the black board's contents. The XCAP-Lite and XCAP-Ltd versions allow use of the *Black Board* for computing values (similar to a spreadsheet), but does not allow inter-connections with other features or creating reports or graphs.

A *Message Log* window lists warnings and errors that arise from performing various operations. By default, the message log window appears automatically when a message is added, and disappears a few seconds later. Auto appearance, auto hide, and audible clicks can be disabled (from the message log window's menu bar). The menu-bar's *Message Log* allows explicit activation of the message log window.

The *Program Setup* shows information about the installed XCAP components, such as their revision level, and sets various configuration options. For versions of XCAP which require an authorization key, it also shows the ID of the key required by the instant copy of XCAP.

The *Program Setup* allows specifying the name of a script to be executed when XCAP starts, whether warning pop-up windows (if any) are to be shown, whether previously saved settings are to be loaded, and other similar initial or terminal conditions.

The *Program Setup* also enables user-defined translation of XCAP labels and messages for use in non-English speaking countries. The XCAP-Lite version does not support creating user-defined translated labels and messages, but may use translated labels and messages previously created with XCAP.

The *Windows Info* displays information about the current Windows environment, such as memory usage and the graphics display systems (S/VGA) features, as reported by Windows. The *Linux Info* displays information about the current Linux environment, such as memory usage and the graphics display systems (S/VGA) features, as reported by Linux. The *Java Info* displays information about the status of Java, under which XCAP runs. Both of these features are primarily of use in resolving questions submitted to EPIX, Inc. Technical Support.

The *Window Style* allows setting some characteristics of XCAP windows, such as color or character size and font. Some characteristics of window style are instead controlled by the Windows Control Panel.

The *Audio Clip* (only under Windows) allows recording and playing short audio "clips".

The *RS-232 Control* allows "raw" communication with a camera or other device connected via the computer's RS-232 port. The *RS-232 Control* is designed specifically for device control, including options to communicate with byte values, rather than as a common "terminal emulator". XCAP may also provide more convenient, camera-specific "smart" controls, provided after a camera-specific imaging board is opened, via the Capture - Adjustments.

The *I/O Port Peek & Poke* allows controlling arbitrary devices accessible via I/O port peeks and pokes. This feature must be used with caution; peeking or poking arbitrary ports will cause computer malfunction! This feature is only available under Windows 95/98/ME.

The *Screen Capture* allows capturing the current graphics display (S/VGA) screen, saving the graphics to a file, or printing the graphics. The *Screen Capture* also allows capturing numeric and textual parameters into a text file, suitable for loading into a spreadsheet or other programs. The XCAP-Lite version does not support screen capture.

The *Volpi intralux dc-1100* and *Illumination Technologies 3900* provide support for controlling these light sources through their RS-232 ports.

6.1.5. Main Window - PIXCI®

The main window's *PIXCI®* allows initiating access to the PIXCI imaging board and provides configuration options. Actual operation of the PIXCI imaging board is performed through the PIXCI image viewer window's menu-bar.

The *PIXCI® Open/Close* allows opening access to, or closing access to, the PIXCI imaging board. Once open, the model (and submodel, as appropriate) of the PIXCI imaging board is available via the *Board Info* button. After opening, the contents of the PIXCI image board's frame buffer(s) are displayed in The Image Viewer Window, along with a tool bar of PIXCI® Image Viewer - Capture - Shortcuts and a status bar of PIXCI® Image Viewer - View - Status Bar are shown as described below.

The *PIXCI® Video Setup* allows configuring the video format, video resolution and other, model

specific, video characteristics. For example, for PIXCI SV2, SV3, SV4, SV5, and SV5A models, the *PIXCI® Video Setup* allows selecting NTSC, RS-170, S-VIDEO, CCIR, or PAL, allows selecting the video window size and capture resolution, and selecting other video acquisition characteristics. For other models, such as the PIXCI® D, D2X, or CL1 fewer options may be provided, as the PIXCI® D, D2X, and CL1 models are camera specific.

The current video setup is automatically saved when access to the PIXCI imaging board is closed, and reloaded when the PIXCI image board is later opened. The *PIXCI® Save Video Setup* and *PIXCI® Load Video Setup* may be used to explicitly save or reload the current video setup, such as to choose amongst several favorite setups, or to export the current video setup to the XCIP program or the XCLIB library.

The *PIXCI® Status* shows the PIXCI imaging board's current status, such as the state of the general purpose (previously referred to as an external TTL) trigger input(s) and output(s), the number of elapsed video fields, the board's model and submodel, and configured image memory size.

The *PIXCI® Serial Peek & Poke* allows "raw" communication with a camera connected to the serial port on selected models of the PIXCI® imaging board. XCAP may also provide more convenient, camera-specific "smart" controls, provided after a camera-specific imaging board is opened, via the Capture - Adjustments.

The *PIXCI® Connections* provides, as appropriate for the specific model of PIXCI imaging board, a map of the board's connections, connectors, option jumpers, and adjustments.

The *PIXCI® Camera Info* provides a list of cameras and video formats supported by XCAP and various PIXCI® imaging boards. The *PIXCI® Camera Info* also allows viewing a non-operational Capture - Adjustments window (i.e. the "Control Panel", which provides integrated control of both imaging board and any supported camera).

The *PIXCI® TWAIN Sourcery* (only under Windows) allows using XCAP, in conjunction with the "XCAP Sourcery" TWAIN driver, as a component of a "smart" TWAIN Source, allowing other applications to capture images from the PIXCI® imaging board, while XCAP provides imaging board, camera controls, and, optionally, image preprocessing.[8] (The XCAP-Lite and XCAP-Ltd versions do not provide image preprocessing). The *PIXCI® TWAIN Sourcery* should not be confused with *TWAIN New Acquire*; the former allows XCAP to provide image data to other, TWAIN compliant applications; the latter allows XCAP to accept image data from other TWAIN compliant sources. The *TWAIN New Acquire* should never be used to attempt to acquire image data from the *PIXCI® TWAIN Sourcery*!

The *PIXCI® Image-Pro Sourcery* (olny under Windows) allows using XCAP, in conjunction with the "XCAP Sourcery" Image-Pro driver, as a component of a "smart" video source, allowing Image-Pro to capture images from the PIXCI® imaging board, while XCAP provides imaging board, camera controls, and, optionally, image preprocessing.[9]

6.2. The Image Viewer Window

Each image buffer (sequence), or frame buffer (sequence), is displayed in an image viewer window, which is the focus of activity for examining, processing, or analyzing that image buffer (sequence). The image viewer window provides a menu bar with *File*, *View*, *Examine*, *Modify*,

Measure, *Draw*, *AOI*, and *Help* features. The image viewer window associated with the PIXCI imaging board's frame buffer(s) also provides a *Capture* feature.

6.2.1. Image Viewer - File

The image viewer window's *File* allows saving, loading, or printing the image, shows information about the image's dimensions, pixel depth and color space, and allows closing the image viewer window.

The *Load Image* and *Save Image* allow saving or loading the image in a variety of file formats. The *Load Image*, unlike the *Load New Image* described above, loads an image file into the current image buffer, resizing and/or color converting to fit the image buffer's existing dimensions, pixel depth, and color space. The *Load Image* can also load images directly from an Internet URL. The XCAP-Lite version does not support loading images directly from an Internet URL.

For image viewer windows associated with an image buffer sequence, the *Save Image Sequence* and *Load Image Sequence* allow saving or loading multiple images of the sequence as a numbered sequence of image files, or as a single TIFF or AVI format image file with multiple images. The XCAP-Lite version does not support loading or saving of image buffer sequences in a single operation; however multiple uses of *Load Image* or *Save Image* can load or save each image buffer of a sequence. The *Save Image* can also save images directly to an FTP URL. The XCAP-Lite version does not support saving images directly to an FTP URL.

The *E-Mail Image* allows directly e-mail'ing the image, in a variety of file formats, from within XCAP. The XCAP-Lite version does not support the *E-Mail Image* feature.

The *Print, Windows* and *Print, PXIPL* allow printing the image; the former printing via Windows and supporting a wide variety of printers, the latter printing via the PXIPL library and supporting only the most popular printers, but providing precise control of print options. The XCAP-Lite version does not allow printing via the PXIPL library.

The *Attributes* shows the image's (or image sequence's) dimensions, pixel depth, and color space.

The *Duplicate Image* and *Duplicate Image Sequence* allows creating a new image buffer and copying the current image, or creating a new sequence of image buffers and copying the current image sequence, respectively, in one step. It optionally allows copying the image's (or image sequence's) current appearance, as modified by the palette and graphics, instead of the underlying image (or image sequence). The XCAP-Lite version does not provide *Duplicate Image* or *Duplicate Image Sequence*.

The *Copy to Black Board* allows copying the image's pixel values into the Black Board. The XCAP-Lite and XCAP-Ltd versions do not provide *Copy to Black Board*.

The *Close Viewer* closes the window, but does not destroy the image (sequence). The *Close & Dispose of Image* closes the window and destroys the image (sequence). The image viewer window associated with the PIXCI imaging board's frame buffer(s) does not provide a *Close & Dispose of Image*; an image viewer window is available whenever the PIXCI imaging board is open for use.

6.2.2. Image Viewer - View

The image viewer window's *View* provides options governing the appearance of the displayed image.

The *Shortcuts* allows activating or deactivating a tool bar of icons providing shortcuts for accessing often used features, and is described under Image Viewer - View - Shortcuts.

The *Status Bar* allows activating or deactivating a small status bar with current information, and is described under Image Viewer - View - Status Bar.

For image viewer windows associated with the PIXCI image board's frame buffer(s), the *Adjustments* allows setting common adjustments, as suitable for the model of the PIXCI imaging board in use, and is described under PIXCI® Image Viewer - Capture.

The *Full Screen* allows displaying the image in the full graphics display (S/VGA) screen, with little or no window "frame" around the image. A mouse click, anywhere on the graphics display (S/VGA) screen, restores the previous mode. The XCAP-Lite version does not provide the *Full Screen* feature.

The *Always-On-Top* allows forcing the image viewer window, and its subwindows, to always be "above" other windows; subject to the other windows' also requesting *Always-On-Top*, and the whims of the host operating system. This option is typically useful only when XCAP is being used in combination with other applications, such as in conjunction with the *PIXCI® TWAIN Sourcery* or *PIXCI® Image-Pro Sourcery* feature.

The *Refresh* forces the displayed image to be redrawn once; normally manual refresh is not needed, but occasionally, when the image was (partly) covered and uncovered by other window (s), the displayed image might "forget" to be updated.

For images composed of index pixels and palette, the *Image's Palette* allows manipulating the image's attached palette; for images of other types, the *Image's Palette* is not selectable. For all images, the *Viewer's Palette* allows manipulating a palette which is not attached to the image. Either can be used for contrast enhancement, adjustment of black level and gain, or, for monochrome images, false coloring. Either, or neither, of the palettes can be selected for use under *Display*.

For image sequences, the *Sequence Play* allows "playing" the sequence, image by image, at a selected rate. The *Sequence Thumbnails* shows a window in which each image of the sequence is a small "snapshot"; clicking a snapshot selects that image for display by the image viewer window. The XCAP-Lite version does not provide the *Sequence Thumbnails*.

The *Cursor* allows activating a cursor over the image, which may be positioned via coordinates, or by clicking the mouse on an image feature.

The *Display* allows selecting how the image is displayed: (a) No resizing so that there is a one to one relationship between an image pixel and a displayed graphics display (S/VGA) pixel and is quickest, although the entire image may not fit within the window and must therefore be panned and scrolled, (b) Resize by nearest neighbor which is relatively quick, or (c) Resize by bilinear interpolation which may produce better results for continuous tone images, but is slower. For the resize modes, the aspect ratio can also be modified. The *Display* allows selecting which palette, if any, is to be used during display and during file loads and saves. An option to display only even

lines, or only odd image lines, allows avoiding interlace artifacts during display. For the image viewer window associated with the PIXCI imaging board's frame buffer(s), the *Display* provides additional features, identical to the *Live Options* described below.

The *Zoom, Pan, Scroll* allows magnifying the displayed image, and panning and scrolling to view different portions of the image under magnification. For image sequences, a specific image of the sequence can be selected for display. In addition to panning and scrolling via explicit coordinates and via scrollbars, holding the right mouse button and moving the mouse over the image also implements panning and scrolling.

Each image buffer (sequence) may have several simultaneously active viewers, allowing, for example, viewing the same image buffer both magnified and unmagnified. The *Launch 2nd Viewer* creates a second image viewer window into the same image buffer (sequence), with the same features as the original image viewer window. The XCAP-Lite version does not provide the *Launch 2nd Viewer* feature.

6.2.3. Image Viewer - Examine

The image viewer window's *Examine* provides options to examine the image.

The *Pixel Peek* allows numeric display of the pixel values in the vicinity of the image cursor.

The *Pixel Peek & Poke* allows numeric display and modification of the pixel value at the image cursor.

The *Pixel Plot* displays a two-dimensional graph of pixels values along a selected image line or column, all image lines, or for image sequences, a vector. Features attached to the graph show specific pixel values and descriptive statistics such as lowest value, highest value, mean value, and standard deviation. The XCAP-Lite version does not provide a graph of all image lines, and does not provide descriptive statistics.

The *Pixel Plot 3D* displays a three-dimensional graph projection of the image.

The *SMPTE VITC* allows searching the image for valid SMPTE Vertical Interval Time Codes and displaying the decoded codes.

The XCAP-Lite and XCAP-Ltd versions do not provide the *SMPTE VITC* features.

6.2.4. Image Viewer - Modify

The image viewer window's *Modify* provides image processing operations which modify the image, modify each image (independently) in a sequence (typically named "Sequence ...") or modify one or more images in a sequence by combining data from across multiple images (typically named "... Sequence)."

The *Patterns* draws various test patterns in the image. The *Sequence Patterns* does the same on each image of a sequence.

The *Set* sets image pixels to a specified value. The *Sequence Set* does the same on each image of a

sequence.

The *Arithmetic* provides pixel arithmetic, such as adding a constant value. The *Sequence Arithmetic* does the same on each image of a sequence. The *Src+Dst Arithmetic* does the same with distinct source and destination images.

The *Binning* provides averaging or integrating pixel values in "bins" of a checkerboard. The *Sequence Binning* does the same on each image of a sequence. The *Src+Dst Binning* does the same with distinct source and destination images.

The *Contrast Modification* allows modifying the image's contrast. The *Sequence Contrast Modification* does the same on each image of a sequence. The *Src+Dst Contrast Modification* does the same with distinct source and destination images.

The *Convolution* allows convolving the image with user-defined kernels. The *Sequence Convolution* does the same on each image of a sequence. The *Src+Dst Convolution* does the same with distinct source and destination images.

The *Correlation Map* allows correlating, or matching, a kernel image over a larger image, resulting in a profile image whose intensity, at each location, varies in proportion to the degree of match, at that location. The *Sequence Correlation Map* does the same on each image of a sequence. The *Src+Dst Correlation Map* does the same with distinct source and destination images.

The *Edge Detection* provides Kirsch, Sobel, and other standard edge detectors. The *Sequence Edge Detection* does the same on each image of a sequence. The *Src+Dst Edge Detection* does the same with distinct source and destination images.

The *FFT* provides Fast Fourier Transforms and Discrete Fourier Transforms. The *Sequence FFT* does the same on each image of a sequence. The *Src+Dst FFT* does the same with distinct source and destination images.

The *Interlace & Flicker* provides line and pixel shuffling operations. The *Sequence Interlace & Flicker* does the same on each image of a sequence. The *Src+Dst Interlace & Flicker* does the same with distinct source and destination images.

The *Morphology* provides morphological operations with user-defined kernels. The *Sequence Morphology* does the same on each image of a sequence. The *Src+Dst Morphology* does the same with distinct source and destination images.

The *Noise Generator* allows adding pseudo-random noise with uniform and other distributions to an image. The *Sequence Noise Generator* does the same on each image of a sequence. The *Src+Dst Noise Generator* does the same with distinct source and destination images.

The *Normalization* provides intensity normalizations based upon a single image. The *Sequence Normalization* does the same on each image of a sequence. The *Src+Dst Normalization* does the same with distinct source and destination images.

The *Rotation & Shift* provides image rotations and shifts. The *Sequence Rotation & Shift* does the same on each image of a sequence. The *Src+Dst Rotation & Shift* does the same with distinct source and destination images.

The *Spatial Filtering* provides low pass, high pass, and other filters. The *Sequence Spatial Filtering* does the same on each image of a sequence. The *Src+Dst Spatial Filtering* does the same with distinct source and destination images.

The *Spatial Normalization* provides spatial normalizations based upon a single image. The *Sequence Spatial Normalization* does the same on each image of a sequence. The *Src+Dst Spatial Normalization* does the same with distinct source and destination images.

The *Threshold* allows thresholding an image against user-defined, fixed, boundary values. The *Sequence Threshold* does the same on each image of a sequence. The *Src+Dst Threshold* does the same with distinct source and destination images.

The *Threshold, Adaptive* allows thresholding an image against boundary values that are automatically adjusted. The *Sequence Threshold, Adaptive* does the same on each image of a sequence. The *Src+Dst Threshold, Adaptive* does the same with distinct source and destination images.

The *Warp* allows "rubber-sheet" transformations governed by a list of initial and final fiducial locations. The *Sequence Warp* does the same on each image of a sequence. The *Src+Dst Warp* does the same with distinct source and destination images.

The *Copy & Resize* allows copying and resizing an image from one image buffer to another.

The *Pair Arithmetic* provides pixel arithmetic, such as summation, between one image buffer and another. The *Src+Dst Arithmetic* does the same with distinct pair of source and destination images.

The *Pair Normalization* allows normalizing various intensity based attributes of an image, based upon a second reference, or background, image. The *Src+Dst Normalization* does the same with distinct pair of source and destination images.

The *Sequence Average* allows forming the average or sum of an image sequence.

The *Difference Sequence* allows forming the difference of each pair of images of an image sequence.

The *Tile Sequence* allows forming a grid of reduced images from an image sequence.

For image copy and other image processing operations utilizing a distinct source and destination, the image viewer window from which the operation is selected is always the modified destination; an image (or sequence) associated with a different image viewer window can be selected as the unmodified source.

The XCAP-Lite and XCAP-Ltd versions only provide the *Patterns* and *Set* features.

6.2.5. Image Viewer - Measure

The image viewer window's *Measure* provides features for image measurement and analysis, including user-defined coordinate systems and mapping intensities into user-defined units.

The *Intensity Calibration* allows creating a mapping (correspondence) from monochrome image

pixel values into user-defined units, for example from grey level into brightness, or grey level into density of material.

The *Spatial Calibration* allows creating a mapping (correspondence) from pixel X,Y coordinates into a user-defined H,V coordinate system. The H,V coordinates may be translated, scaled, and/or rotated with respect to X,Y coordinates.

The *Histogram* computes and displays a graph of an image's histogram.

The *Histogram Pair* computes and displays a graph of the histogram of difference of a pair of images.

The *Mass & Moments* computes and displays various moments of an image.

The *Line Profile* displays a two-dimensional graph of pixels values along an arbitrary oriented line, arc, polyline, Bezier, and other curves.

The *Radial Mass Plot* displays a two-dimensional graph of the sum of pixel values versus the pixels' distance from an origin.

The *Ruler* overlays a ruler on the image, with user-defined length, width, and tick marks, all based on the H,V coordinate system. Multiple rulers can be overlaid on each image.

The *Protractor* overlays a protractor on the image, with user-defined radius, arc, and tick marks, all based on the H,V coordinate system. Multiple protractors can be overlaid on each image.

The *Cartesian Reticle* overlays a Cartesian coordinate reticle on the image, based on the H,V coordinate system. Multiple Cartesian reticles can be overlaid on each image.

The *Polar Reticle* overlays a polar coordinate reticle on the image, based on the H,V coordinate system. Multiple polar reticles can be overlaid on each image.

The *Distance & Angle Crosshairs* provides spatial calibration and measurement of absolute position, relative position, length and angles. While these capabilities are also available elsewhere in Image Viewer - Measure and Image Viewer - Draw, the *Distance & Angle Crosshairs* collects chosen features to provide a single window with the equivalent of a so-called "Video Crosshair Overlay & Measurement" system.

The *Shape Analysis* provides descriptive statistics about the shape of elliptical, rectangular, or polygonal regions.

The *Blob Analysis* identifies image blobs, based upon thresholding the image into foreground and background, and provides descriptive statistics about the blobs found.

The *Particle Tracking* provides identification and tracking of particles (blobs) over a sequence of images. Individual particles are detected based upon a thresholded (bi-level) image. In one method, multiple image occurrences of a common particle are identified across a sequence of images by position extrapolation and verification. In a second method, vectors of particles that are close together are compared and expected to yield consistent magnitude and direction. In a third method, which requires the fewest setup parameters, common particles are grouped by nearest

neighbor. For any method, the particle's trajectories are displayed and reported.

The *SubPixel Edger* overlays a line or curve tool on the image, analyzes the pixel values under the line or curve finding edges to subpixel accuracy, and displays the position of the edges both graphically, on the image, and numerically.

The *Ellipse Fitter* overlays an elliptical pattern of subpixel edger tools on the image, and computes a best-fit elliptical curve from the edges found.

The *Correlation Finder* correlates, or matches, a kernel image over a larger image, showing the coordinates of, and displaying a box around, the best match(es).

The XCAP-Lite and XCAP-Ltd versions do not provide the *Intensity Calibration*, *Spatial Calibration*, *Histogram*, *Histogram Pair*, *Mass & Moments*, *Radial Mass Plot*, *Ruler*, *Protractor*, *Cartesian Reticle*, *Polar Reticle*, *Distance & Angle Crosshairs*, *Shape Analysis*, *Blob Analysis*, *Particle Tracking*, *SubPixel Edger*, *Ellipse Fitter*, or *Correlation Finder* features. The *Line Profile* is limited to straight lines.

6.2.6. Image Viewer - Draw

The image viewer window's *Draw* provides features for drawing graphics and text over the image. One or more of: line, circle with aspect ratio correction, rotated rectangle, rotated ellipse, arc of circle with aspect ratio correction, arc of rotated ellipse, annulus, arc of annulus, rectangular frame, list of points, polygon, polyline (connected line segments not closed into a polygon), Bezier curve, or Bezier region (Bezier curve closed to form region), rotated text, and arrow may be overlaid over the image (non destructive) or written into the image. The individual menu items such as Text, Line, Rectangle, etc. allow quick drawing of graphics or text. The *Graphic Manager* permits drawing the same graphics or text, but in addition manages a list of graphic or text objects, including loading and saving of the graphic or text objects.

The *Image Overlay* feature allows overlaying a second image, containing graphics on a "transparent" background, over the current image.

The *Paint Brush* feature allows interactive "painting" onto the image with selectable color, patterns, and "brush" shapes.

The *Paint Fill* feature allows filling (flooding) an image region with "paint" of selectable color and patterns, using specified pixel values as the boundary terminating the "filling".

The XCAP-Lite version only provides the graphic line feature.

6.2.7. Image Viewer - AOI

The image viewer window's *Aoi* allows defining areas of interest (AOI) and regions of interest (ROI) upon which future image processing, measurement, analysis, print, load, and save features will operate. As used in XCAP, an "AOI" is a rectangular area with sides parallel to the image axis, while an "ROI" is of arbitrary shape, such as an ellipse or rectangle which may be rotated with respect to the image axis, or an arbitrary path or polygon. The image print, load, save, and many other features only allow use of an AOI; selected image processing, measurement, analysis and other features also allow use of an ROI.

The *Set AOI* defines the default area of interest and color space upon which future image processing, printing, load, and save features will operate.

The *Set ROI* defines the default region of interest and color space upon which future image measurement, analysis, and other selected features which accept an ROI will operate.

The *Set Full Image* quickly sets the default area of interest and region of interest to the image's full dimensions, and the default color space to the image buffer's natural color space, without entering the *Set AOI* or *Set ROI* window.

The *AOI/ROI Manager* maintains a list of often used areas of interest (AOI) and regions of interest (ROI).

Within each of the image processing, measurement, analysis, print, load, and save features a different AOI (or ROI, if applicable) can be selected, temporarily overriding the default AOI (or ROI). Within the feature, the new AOI (or ROI) can be specified numerically or interactively drawn, or an AOI (ROI) previously defined within the *AOI/ROI Manager* can be selected.

6.2.8. Image Viewer - View - Shortcuts

A tool bar of icons provides shortcuts for accessing often used features of The Image Viewer Window. Selected shortcuts can also be activated by key clicks when the tool bar window as the "input focus" (e.g. that window's title bar is highlighted). The shortcuts provided are:

a. Switch to first buffer of sequence (*Key HOME*).

b. Switch to next buffer of sequence (*Key PAGE UP*).

c. Switch to previous buffer of sequence (*Key PAGE DOWN*).

d. Switch to last buffer of sequence (*Key END*).

e. Copy image to new image buffer.

f. Adjust palette.

g. Zoom, scroll, and pan.

h. Peek at numeric pixel values.

i. Activate or deactivate cursor overlay.

j. Two-dimensional plot of line or column of pixel values.

k. Histogram of pixel values.

l. Select resizing of the image to fit The Image Viewer Window, or no resizing so that there is a one to one relationship between an image pixel and a graphics display system's (S/VGA) pixel (although the entire image may not fit within the window and must therefore be

panned and scrolled, and the displayed aspect ratio will be incorrect for image's whose aspect ratio differs from the graphics display system's (S/VGA's) aspect ratio).

The first four shortcuts appear only for The Image Viewer Windows which access a sequence of images.

The shortcuts may either be attached and part of The Image Viewer Window, or may be detached into its own window, as set by *Display* under Image Viewer - View.

6.2.9. Image Viewer - View - Status Bar

A status bar provides information about the image resolution, current cursor coordinates, current buffer of a sequence, and other similar information. The information to be shown can be selected by *Display* under Image Viewer - View.

6.2.10. PIXCI® Image Viewer - Capture

The image viewer window associated with the PIXCI image board's frame buffer(s) has *Capture* which provides for capturing images from the PIXCI imaging board and other features associated with the PIXCI imaging board. Any additional image viewer windows created by *Launch 2nd Viewer* do not provide *Capture*, but only view, modify, examine, and/or draw the frame buffers.

The *Adjustments* allows setting common adjustments, as suitable for the model of the PIXCI imaging board in use. For example, for PIXCI® SV2, SV3, SV4 SV5, and SV5A models, the *Adjustments* allows selecting the video input connection and adjusting the gain, black level, hue, and saturation. Less frequently used, and more esoteric, adjustments may be found under *PIXCI® Video Setup*, described above. A duplicate *Adjustments* is provided under Image Viewer - View.

The *Shortcuts* activates or deactivates the PIXCI® Image Viewer - Capture - Shortcuts, described below. A duplicate *Shortcuts* is provided under Image Viewer - View.

The *Snap* captures and displays a single image. The *Live* continuously captures and displays images; the *UnLive* terminates the *Live* mode, displaying the last captured image.

The *First Buffer* switches to the first buffer of the frame buffer sequence, the *Last Buffer* switches to the last buffer of the frame buffer sequence, the *Next Buffer* switches to the next buffer of the frame buffer sequence, and the. *Previous Buffer* switches to the previous buffer of the frame buffer sequence.

The *GIO Event Capture* provides single or sequence image capture, each image triggered in conjunction with the imaging board's general purpose (previously referred to as an external TTL) input and output signals. The XCAP-Lite version does not provide the sequence option of the *GIO Event Capture* feature.

The *Sequence Capture* features allow capturing a timed sequence of images. The *Sequence Capture* features may be started by an event (trigger), run continuously until stopped by an event, or each individual image captured in response to an event. Events include mouse clicks, time of day, and the imaging board's general purpose (previously referred to as external TTL) inputs; when used with general purpose input events the *Sequence Capture* differs from *GIO Event Capture* in that the latter provides more options and higher accuracy and repeatability for the manipulation of the

general purpose inputs and outputs in response to video timing. former starts the entire sequence upon a single event (trigger), When recording at subvideo rates, a time stamp feature allows recording the time that each image was captured, and either overlaying the time nondestructively or permanently marking the image with the time.

A variety of *Sequence Capture* features provide tradeoffs between capture rate vs. convenience vs. total number of images captured. The *Video to Frame Buffers* captures sequences directly into pre-configured frame buffer memory, and can support any video rate or bandwidth. The *Video to Memory Buffers* captures and copies sequences into convenient dynamically allocated host computer (virtual) memory, but may not support high video rate or bandwidth sequence capture for all cameras on all computers. The *Video to Disk File* captures and copies sequences into a disk file in an efficient, internal format (after capture the sequence can be saved in a standard format). The *Video to Image Files* captures and copies sequences directly into standard format image files, but may not obtain as high video rate capture as the *Video to Disk File* feature. The XCAP-Lite version does not provide the *Video to Image Files* or *Video to Disk File* features, or the time stamp feature, or the event (trigger) option of the *Video to Frame Buffers* or *Video to Memory Buffers* features.

The *Waterfall Display* displays a chosen line of the frame buffer, in a "waterfall" fashion, updating the screen once per field, or as often as the host computer's speed allows. This feature is primarily intended for adjusting line scan type cameras. The waterfall display is intended only for viewing; it can't be analyzed, and can be saved only as a side effect of *Screen Capture*.

The *Video to StreamStor* (only under Windows) allows recording and playing video to and from Boulder Instruments StreamStor High-Speed Disk Recorders, allowing recording at video rate with almost all cameras and resolutions. The *Video to StreamStor* is provided only in the XCAP-Plus version.

The *RGB Merge* allows interpreting and viewing three monochromatic frame buffers as a single color (e.g. RGB) image, with adjustments for registration and coloring. The XCAP-Lite version does not provide the *RGB Merge* feature.

The *Quad Pixel Merge* allows interpreting and viewing four monochromatic frame buffers, each one captured after shifting the image sensor by ½ pixel horizontally and vertically, as a single high resolution image. The XCAP-Lite and XCAP-Ltd versions do not provide the *Quad Pixel Merge* feature.

The *Frame Average* allows performing recursive, continuous, averaging of live video frames (or fields) and viewing the live result. The XCAP-Lite and XCAP-Ltd versions do not provide the *Frame Average* feature.

The *Live Options* combines the *View - Display* options, above, with additional choices governing *Live* mode. During *Live* mode, the PIXCI imaging board can, (a) Capture continuously into the specified frame buffer, however the image shown on the graphics display (S/VGA) may contain portions from different video frames, (b) Snap, display on the graphics display (S/VGA), and repeat, however the image display rate will be slower, or (c) Alternate capturing into the specified frame buffer and the last frame buffer (dual buffering). On host computers with insufficient PCI bandwidth to simultaneously capture into host computer memory and display from host computer memory to the graphics display (S/VGA), option (b) reduces the required bandwidth by approximately half.

6.2.11. PIXCI® Image Viewer - Capture - Shortcuts

A tool bar of icons provides shortcuts for accessing often used features of the PIXCI imaging board, and is an extension of the Image Viewer - View - Shortcuts described above. Selected shortcuts can also be activated by key clicks when the tool bar window as the "input focus" (e.g. that window's title bar is highlighted). The shortcuts provided are:

a. Switch to first buffer of frame buffer sequence (*Key HOME*).

b. Switch to next buffer of frame buffer sequence (*Key PAGE UP*).

c. Switch to previous buffer of frame buffer sequence (*Key PAGE DOWN*).

d. Switch to last buffer of frame buffer sequence (*Key END*).

e. Snap single image (*Key S*).

f. Toggle between:

   - Live mode - continuously capture and display images (*Key L*), and
   - Unlive mode - cease continuously capturing and displaying (*Key U*).

g. Duplicate image.

h. Adjust palette.

i. Zoom, scroll, and pan.

j. Activate or deactivate cursor overlay.

k. Select resizing of the image to fit The Image Viewer Window, or no resizing so that there is a one to one relationship between an image pixel and a graphics display system's (S/VGA) pixel (although the entire image may not fit within the window and must therefore be panned and scrolled, and the displayed aspect ratio will be incorrect for image's whose aspect ratio differs from the graphic display system's (S/VGA's) aspect ratio).

l. Peek at numeric pixel values.

m. Two-dimensional plot of line or column of pixel values.

n. Histogram of pixel values.

o. Sequence acquire.

p. Sequence display.

The shortcuts may either be attached and part of PIXCI® Image Viewer Window, or may be detached into its own window, as set by *Display* under Image Viewer - View.

6.3. Other Features

Other useful features of XCAP are associated with many, or all, of its windows.

Most windows of XCAP provide fields for numeric entry. Typically, to the right of the numeric entry field are two up/down or left/right buttons. Left clicking a button allows incrementing or decrementing the numeric value. Left clicking within a button's shaded area yields larger increment or decrement values, depending on the distance from the opposite button.

Right clicking either button (or the area between buttons), yields an options menu. The options menu typically provides the following:

i. Selecting the base to which integer numbers are displayed, or the format and precision to which non-integer numbers are displayed.

ii. Changing the increment and decrement values to be applied when the buttons are left clicked.

iii. Activating a "ScrollPad" (a miniature scroll bar which overlays the displayed number) allowing adjustment of the numeric value with mouse clicks and drags.

iv. Selecting units and range for display of angles, such as 0 to 360 degrees, -180 degrees to +180 degrees, 0 to 2pi radians, or -pi to +pi radians.

v. Selecting units for display of temporal intervals, such as milliseconds, seconds, minutes, or hours.

vi. Selecting units for display of lengths, such as millimeters, centimeters, meters, inches, or feet.

vii. Selecting units for display of frequencies, such as Hertz, kiloHertz, megaHertz, or the frequency's period in milliseconds or microseconds.

viii. Selecting units for display of memory sizes, such as bytes, kilobytes, megabytes, or gigabytes.

ix. Selecting units for display of temperature, such as Fahrenheit, Celsius, or Kelvin.

x. Connecting the field to receive new content from a specified cell of the *Black Board*, or connecting the field to transmit its content to a specified cell of the *Black Board*.

xi. Providing a larger field in which to view or enter a number.

xii. Providing a field in which an entered mathematical expression is evaluated to a numeric value.

xiii. Editing controls such as *Cut*, *Copy*, *Paste*, and *Delete*.

Numeric fields which only display computed results, text entry fields, and text display fields, may provide some of the above options — accessed by right clicking the field.

Some numeric fields may have an explicit "slider" control in addition to the implicit "ScrollPad". Right clicking the slider allows enlarging a portion of the slider's range for finer control.

Various windows of XCAP provide fields for entry of pixel colors. Typically, the color can be entered numerically, and a small color "swatch" appears next to the color entry field, showing the selected color. Right clicking the swatch activates a color cylinder from which new colors may be selected by mouse clicks.

Editing of numeric and text fields follows standard conventions. In brief, mouse click once or use left/right arrow keys to position the caret - characters are inserted at the caret as typed. Double mouse click to highlight all text or single click and drag to highlight a portion of text - a Delete or Backspace removes the highlighted text, a character replaces the highlighted text, and the left/right arrow keys cancel the highlight mode.

The user interface can be navigated without a mouse by using Tab and Shift-Tab to shift input focus, arrow keys and PgUp/PgDn to scroll, arrow keys to select tabs and list items, Enter to select choices and push buttons, and Alt-Tab (under Windows) or Ctrl-Alt-Tab (under Linux) to select a Window.

6.4. Road Map - Main Window

```
Main Window

    File
        Load New Image
        Load New Image Sequence
            TIFF
            JPEG/JFIF
            BMP
            FITS
            Multimedia
        Image File Info
        TWAIN Select Source
        TWAIN New Acquire
        Window List
         -- List of current windows
        Exit

    Images
        New Image
        -- List of current images

    Scripts
        Script Record
        Script Play
        Script Remote Control
        Script Edit
        Script Tools
        Load Tool Bar
        Freeze Display
        Thaw & Refresh Display

    Utility
        Black Board
        Message Log
        Audio Clip (Windows only)
        RS-232 Control
        Screen Capture
        I/O Port Peek & Poke (Windows 95/98/ME only)
```

```
        Program Setup
        Windows Info (Windows only)
        Linux Info (Linux only)
        Window Style
        Java Info
        Devices
            Volpi intralux dc-1100
            Illumination Technologies 3900

    PIXCI®
        PIXCI® Open/Close
            Board Info
            Driver Assistant
        PIXCI® Video Setup
            Format  (dependent on imaging board)
            Resolution
            Sync
            Custom

        PIXCI® Save Video Setup
        PIXCI® Load Video Setup
        PIXCI® TWAIN Sourcery (Windows only)
        PIXCI® Image-Pro Sourcery (Windows only)
        PIXCI® Status
        PIXCI® Serial Peek & Poke
        PIXCI® Connections
        PIXCI® Camera Info

    Help
        About
        License
        XCAP Release Notes
        XCAP Reference Manual
        PC Configuration Tips
```

6.5. Road Map - PIXCI Image Viewer Window

```
PIXCI Image Viewer Window

    File
        Save Image
            TIFF
            JPEG/JFIF
            BMP
            FITS
            PCX
            Targa
            X/Y Binary
            X/Y ASCII

        Load Image
            TIFF
            JPEG/JFIF
            BMP
            FITS
            X/Y Binary
            X/Y ASCII

        Save Image Sequence
            One TIFF w. Sequence
            One AVI w. Sequence
            Sequence of TIFF
            Sequence of JPEG/JFIF
            Sequence of BMP
            Sequence of FITS
```

- Sequence of PCX
- Sequence of Targa (TGA)
- Sequence of X/Y Binary
- Sequence of X/Y ASCII

Load Image Sequence
- One TIFF w. Sequence
- One AVI w. Sequence
- Sequence of TIFF
- Sequence of JPEG/JFIF
- Sequence of BMP
- Sequence of FITS
- Sequence of X/Y Binary
- Sequence of X/Y ASCII

E-Mail Image
Save Frame Buffer Memory
Load Frame Buffer Memory
Print, Windows
Print, PXIPL
Duplicate Image
Duplicate Image Sequence
Copy to Black Board
Attributes
Close Viewer

View
- Shortcuts
- Adjustments
- Status Bar
- Full Screen
- Always-On-Top
- Refresh
- Image's Palette
- Viewer's Palette
  - Black & Gain
  - Numerically
  - Band Coloring
  - Bit Slice
  - Bit Transposition
  - White Balance

Sequence Play
Sequence Thumbnails
Cursor
Display
Zoom, Pan, Scroll
Launch 2nd Viewer

Examine
- Pixel Peek
- Pixel Peek & Poke
- Pixel Plot
  - Plot Row
  - Plot Column
  - Plot Buffer
  - Plot All Rows

Pixel Plot 3D
SMPTE VITC

Modify
- Patterns [Sequence Patterns]
- Set [Sequence Set]
- Arithmetic [Sequence Arithmetic] [Src+Dst Arithmetic]
  - Complement Pixels
  - Bit Wise Logical AND Pixels w. Mask

```
    Bit Wise Logical XOR Pixels w. Mask
    Bit Wise Logical OR Pixels w. Mask
    Bit Shift Left
    Bit Shift Right
    Add Constant with Pixels
    Multiply Constant with Pixels
    Add Uniform Random Dither to Pixels
    Add Gaussian Random Dither to Pixels
    Halftone, Threshold & Carry
    Halftone, Dot Construction
    Gamma Correction
    Pixie Minimum
    Pixie Maximum
    Pixie Mean

Binning [Sequence Binning] [Src_Dst Binning]
    Average
    Integrate
Contrast Modification [Sequence Contrast Modification] [Src+Dst Contrast M
    Stretch Contrast, Pixel Value Endpoints
    Stretch Contrast, Histogram Percentile Endpoints
    Invert Contrast
    Histogram Modification

Convolution [Sequence Convolution] [Src+Dst Convolution]
    Convolve: Convolve(PixelValue)
    Convolve: Abs(Convolve(PixelValue))
    Convolve: PixelValue Convolve(PixelValue)
    Convolve: PixelValue Abs(Convolve(PixelValue))

Correlation Map [Sequence Correlation Map] [Src+Dst Correlation Map]
Edge Detection [Sequence Edge Detection] [Src+Dst Edge Detection]
    Edge Magnitude: Laplacian
    Edge Magnitude: Vertical
    Edge Magnitude: Horizontal
    Edge Magnitude: Sobel
    Edge Magnitude: Kirsch
    Edge Magnitude: Roberts
    Edge Gradient: Log Sobel
    Edge Gradient: Log Sobel Absolute
    Edge Gradient: Log Kirsch
    Edge Gradient: Log Roberts
    Edge Gradient: Thin, Minimal Effect
    Edge Gradient: Thin, Maximal Effect

FFT [Sequence FFT] [Src+Dst FFT]
    FFT to Log Magnitude
    Root Filter
    Gaussian Filter
    Inverse Gaussian Filter

Interlace & Flicker [Sequence Interlace & Flicker] [Src+Dst Interlace & Fl
    Shuffle Line Order to Field Order
    Shuffle Field Order to Line Order
    Transpose Line Pairs
    Transpose Column Pairs
    Shuffle Line Pairs to Pixel Pairs
    Shuffle Pixel Pairs to Line Pairs
    Deflicker: Average Line Pairs
    Deflicker: Filter Singularity

Morphology [Sequence Morphology] [Src+Dst Morphology]
    Erode
    Dilate
    Open
    Close
    Boundary
```

- Hit Miss
- Medial Axis Thin
- Skeleton Thin

Noise Generator [Sequence Noise Generator] [Src+Dst Noise Generator]
- Uniform Noise
- Gaussian Noise
- Rayleigh Noise
- Negative Exponential Noise
- Salt & Pepper Noise

Normalization [Sequence Normalization] [Src+Dst Normalization]
- Normalize Intensity, Blobs & Background
- Normalize Row Mean
- Normalize Column Mean

Rotation & Shift [Sequence Rotation & Shift] [Src+Dst Rotation & Shift]
- X, Y Shift
- Flip
- Skew Left/Right
- Skew Up/Down
- Rotate

Spatial Filtering [Sequence Spatial Filtering] [Src+Dst Spatial Filtering]
- Low Pass Filter
- Sharpen Filter
- Median Filter
- Rank Low (Erode) Filter
- Rank High (Dilate) Filter
- Edge Enhance: Sobel
- Edge Enhance: Sobel Absolute
- Edge Enhance: Kirsch
- Edge Enhance: Roberts

Spatial Normalization [Sequence Spatial Normalization] [Src+Dst Spatial No
- Shift Center of Mass to Center

Threshold [Sequence Threshold] [Src+Dst Threshold]
Threshold, Adaptive [Sequence Threshold, Adaptive] [Src+Dst Threshold, Ada
Warp [Sequence Warp] [Src+Dst Warp]
Copy & Resize
Pair Arithmetic [Sequence Pair Arithmetic] [Src+Dst Pair Arithmetic]
- Add: Dist+Src Modulo PixelSize
- Add: Min(Dst+Src, MaxPixValue)
- Subtract: (MaxPixValue+(Dst Src))/2
- Subtract: (MaxPixValue+(Src Dst))/2
- Subtract: (Dst Src)Modulo PixelSize
- Subtract: (Src Dst)Modulo PixelSize
- Subtract: (Src Dst)Modulo PixelSize
- Subtract: Max(Dst Src, 0)
- Subtract: Max(Src Dst, 0)
- Subtract: Abs(Dst Src)
- Bit Wise AND: Dst & Src
- Bit Wise XOR: Dst ^ Src
- Bit Wise OR: Dst | Src
- Average: (Src+Dst)/2
- Product: (c0*Src+c1)*(c2*Dst+c3)/c4
- Product: (c0*Dst+c1)/(c2*Src+c3)
- Ratio: (c0*Dst+c1)/(c2*Src+c3)
- User-Defined f(PixA, PixB)

Pair Normalization [Sequence Pair Normalization] [Src+Dst Pair Normalizati
- Contrast Modify & Match
- Background Correction, Subtractive
- Background Correction, Ratio
- Spot Mask Correction

- Sequence Average
  - Average Sequence
  - Integrate Sequence
- Difference Sequence
- Tile Sequence

Measure
- Intensity Calibration
- Spatial Calibration
- Histogram
- Histogram Pair
- Mass & Moments
  - Center of Mass
  - Center of Mass, Binary
  - Moments
- Line Profile
- Radial Mass Plot
- Ruler
- Protractor
- Cartesian Reticle
- Polar Reticle
- Distance & Angle Crosshairs
- Shape Analysis
- Blob Analysis
- Particle Tracking
- SubPixel Edger
- Ellipse Fitter
- Correlation Finder

Draw
- Arrow
- Text
- Point
- Points
- Bezier Curve
- Circle
- Circle Arc
- Ellipse
- Ellipse Arc
- Line
- Parallel Lines
- Path Curve
- Polyline
- Rectangle
- Window
- Annulus
- Annulus Arc
- Bezier Region
- Elliptical Annulus
- Elliptical Annulus Arc
- Rectangle Array
- Path Enclosed
- Polygon
- Rectangular Frame
- Graphic Manager
- Image Overlay
- Paint Brush
- Paint Fill

AOI
- Set AOI
- Set ROI
- Set Full Image
- AOI/ROI Manager

Capture

```
    Adjustments
    Shortcuts
    Snap
    Live
    UnLive
    First Buffer
    Last Buffer
    Next Buffer
    Previous Buffer
    Sequence Capture
        Video to Frame Buffers - Single Sequence
        Video to Frame Buffers - Single Sequence w. Event Start
        Video to Frame Buffers - Single Sequence w. Event per Image
        Video to Frame Buffers - Continuous Sequence
        Video to Frame Buffers - Continuous Sequence w. Event Stop
        Video to Frame Buffers - Continuous Sequence w. Event per Image
        Video to Memory Buffers - Single Sequence
        Video to Memory Buffers - Single Sequence w. Event Start
        Video to Memory Buffers - Single Sequence w. Event per Image
        Video to Memory Buffers - Continuous Sequence
        Video to Memory Buffers - Continuous Sequence w. Event Stop
        Video to Memory Buffers - Continuous Sequence w. Event per Image
        Video to Disk File - Single Sequence
        Video to Disk File - Single Sequence w. Event Start
        Video to Disk File - Single Sequence w. Event per Image
        Video to Disk File - Continuous Sequence
        Video to Disk File - Continuous Sequence w. Event Stop
        Video to Disk File - Continuous Sequence w. Event per Image
        Video to Image Files - Single Sequence
        Video to Image Files - Single Sequence w. Event Start
        Video to Image Files - Single Sequence w. Event per Image
        Video to Image Files - Continuous Sequence
        Video to Image Files - Continuous Sequence w. Event Stop
        Video to Image Files - Continuous Sequence w. Event per Image
        Video to StreamStor (Windows only)
    GIO Event Capture

    Waterfall Display
    Video to Disk
    RGB Merge
    Quad Pixel Merge
    Frame Average
    Live Options

Help
    Vis-a-Vis
```

Optionally, the Main Window and the PIXCI Image Viewer Window's may be combined (see Utilities - Program Setup) with the following features of the Main Window added to the PIXCI Image Viewer Window:

```
File
    Window List
     -- List of current windows
    Image List
    -- List of current images
    Exit
Utility
    Message Log
    Program Setup
    Windows Info (Windows only)
    Linux Info (Linux only)
    Window Style
```

```
    Java Info

PIXCI®
    PIXCI® Open/Close
    PIXCI® TWAIN Sourcery (Windows only)
    PIXCI® Image-Pro Sourcery (Windows only)
    PIXCI® Connections
    PIXCI® Video Setup

Help
    XCAP Release Notes
    XCAP Reference Manual
    PC Configuration Tips
    License
    About
```

Optionally, if XCAP is intended to be used solely in conjunction with a TWAIN compliant application or with Image-Pro, many of the menu features of the Main Window and the PIXCI Image Viewer Window may be removed so as to provide a simplified appearance (see Utilities - Program Setup). The same option also removes several PIXCI® Image Viewer - Capture - Shortcuts and adds shortcuts duplicating features of the PIXCI® - TWAIN Sourcery and Image-Pro Sourcery.

6.6. XCAP Software Feature Comparison

Feature	XCAP-Plus	XCAP-Std	XCAP-Ltd	XCAP-Lite (A)	XCAP-Demo (B)
File -					
- Load New Image	Yes	Yes	Yes	Yes (C)	No
- Load New Image Sequence	Yes	Yes	Yes	No	No
- Image File Info	Yes	Yes	Yes	Yes	Yes
- TWAIN Select Source (Win)	Yes	Yes	No	No	No
- TWAIN New Acquire (Win)	Yes	Yes	No	No	No
Images -					
- New Image Workspace	Yes	Yes	Yes	Yes	Yes
Scripts -					
- Record	Yes	Yes	No	No	No
- Play	Yes	Yes	Yes	Yes	No
- Remote Control	Yes	Yes	No	No	No
- Load Tool Bar	Yes	Yes	No	No	No
Utility -					
- Black Board	Yes	Yes	No	No	No

- Message Log	Yes	Yes	Yes	Yes	Yes
- Audio Clip (Win)	Yes	Yes	Yes	Yes	No
- RS-232 Control	Yes	Yes	Yes	Yes	Yes
- Screen Capture	Yes	Yes	Yes	No	No
- I/O Port Peek & Poke (W95)	Yes	Yes	Yes	Yes	Yes
PIXCI® -					
- Open/Close -					
- Single Board	Yes	Yes	Yes	Yes	No
- Multiple Identical Boards	Yes	Yes	Yes	Yes	No
- Multiple Different Boards	Yes	Yes	No	No	No
- Frame Buffer Memory Limit	None (E)	None (E)	None (E)	64 Mbyte (E)	N/A
- Driver Assistant/Wizard	Yes	Yes	Yes	Yes	No
- Video Setup	Yes	Yes	Yes	Yes	No
- Save Video Setup	Yes	Yes	Yes	Yes	No
- Load Video Setup	Yes	Yes	Yes	Yes	No
- TWAIN Sourcery (Win)	Yes	Yes	Yes	Yes	No
- Image-Pro Sourcery (Win)	Yes	Yes	Yes	Yes	No
- Status	Yes	Yes	Yes	Yes	No
- Serial Peek & Poke	Yes	Yes	Yes	Yes	No
- Connections Info	Yes	Yes	Yes	Yes	Yes
- Camera Info	Yes	Yes	Yes	Yes	Yes
- Camera Specific Controls	Yes (F)	Yes (F)	Yes (F)	Yes (F)	No
Help -					
- XCAP Release Notes	Yes	Yes	Yes	Yes	Yes
- XCAP Reference Manual	Yes	Yes	Yes	Yes	Yes
- PC Configuration Tips	Yes	Yes	Yes	Yes	Yes
File -					
- Save Image	Yes	Yes	Yes	Yes (C)	No
- Load Image	Yes	Yes	Yes	Yes (C)	No
- Save Image Sequence	Yes	Yes	Yes	No	No

- Load Image Sequence	Yes	Yes	Yes	No	No
- E-Mail Image	Yes	Yes	Yes	No	No
- Print, Windows	Yes	Yes	Yes	Yes	No
- Print, PXIPL	Yes	Yes	Yes	No	No
- Duplicate Image	Yes	Yes	Yes	No	No
- Duplicate Image Sequence	Yes	Yes	Yes	No	No
- Copy to Black Board	Yes	Yes	No	No	No
View -					
- Full Screen	Yes	Yes	Yes	No	No
- Palette	Yes	Yes	Yes	Yes (G)	Yes (G)
- Sequence Play	Yes	Yes	Yes	Yes	Yes
- Sequence Thumbnails	Yes	Yes	Yes	No	No
- Cursor	Yes	Yes	Yes	Yes	Yes
- Zoom, Pan, Scroll	Yes	Yes	Yes	Yes	Yes
- Launch 2nd Viewer	Yes	Yes	Yes	No	No
Examine					
- Pixel Peek	Yes	Yes	Yes	Yes (H)	Yes (H)
- Pixel Peek & Poke	Yes	Yes	Yes	Yes	Yes
- Pixel Plot Row	Yes	Yes	Yes	Yes (I)	Yes (I)
- Pixel Plot Column	Yes	Yes	Yes	Yes (I)	Yes (I)
- Pixel Plot Buffer	Yes	Yes	Yes	Yes (I)	Yes (I)
- Pixel Plot All Rows	Yes	Yes	Yes	No	No
- Pixel Plot 3D	Yes	Yes	Yes	Yes	Yes
- SMPTE VITC	Yes	Yes	Yes	Yes	No
Modify -					
- Patterns	Yes	Yes	Yes	Yes	Yes
- Set	Yes	Yes	Yes (J)	Yes (J)	Yes (J)
- Arithmetic	Yes	Yes	No	No	No
- Binning	Yes	Yes	No	No	No
- Contrast Modification	Yes	Yes	No	No	No
- Convolution	Yes	Yes	No	No	No
- Correlation Map	Yes	Yes	No	No	No
- Edge Detection	Yes	Yes	No	No	No
- FFT	Yes	Yes	No	No	No
- Interlace & Flicker	Yes	Yes	No	No	No
- Morphology	Yes	Yes	No	No	No

- Noise Generator	Yes	Yes	No	No	No
- Normalization	Yes	Yes	No	No	No
- Rotation & Shift	Yes	Yes	No	No	No
- Spatial Filtering	Yes	Yes	No	No	No
- Spatial Normalization	Yes	Yes	No	No	No
- Threshold	Yes	Yes	No	No	No
- Threshold, Adaptive	Yes	Yes	No	No	No
- Warp	Yes	Yes	No	No	No
- Copy & Resize	Yes	Yes	No	No	No
- Pair Arithmetic	Yes	Yes	No	No	No
- Pair Normalization	Yes	Yes	No	No	No
- Sequence Average	Yes	Yes	No	No	No
- Difference Sequence	Yes	Yes	No	No	No
- Tile Sequence	Yes	Yes	No	No	No
Measure -					
- Intensity Calibration	Yes	Yes	No	No	No
- Spatial Calibration	Yes	Yes	No	No	No
- Histogram	Yes	Yes	No	No	No
- Histogram Pair	Yes	Yes	No	No	No
- Mass & Moments	Yes	Yes	No	No	No
- Line Profile	Yes	Yes	Yes (K,L)	Yes (I,K,L)	Yes (I,K,L)
- Radial Mass Plot	Yes	Yes	No	No	No
- Ruler	Yes	Yes	Yes (K)	Yes (K)	Yes (K)
- Protractor	Yes	Yes	No	No	No
- Cartesian Reticle	Yes	Yes	Yes (K)	Yes (K)	Yes (K)
- Polar Reticle	Yes	Yes	No	No	No
- Dist. & Angle Crosshairs	Yes	Yes	No	No	No
- Shape Analysis	Yes	Yes	No	No	No
- Blob Analysis	Yes	Yes	No	No	No
- Particle Tracking	Yes	Yes	No	No	No
- SubPixel Edger	Yes	Yes	No	No	No
- Ellipse Fitter	Yes	Yes	No	No	No
- Correlation Finder	Yes	Yes	No	No	No
Draw -					
- Arrow	Yes	Yes	Yes	Yes	Yes
- Text	Yes	Yes	Yes	No	No

- Point	Yes	Yes	Yes	No	No
- Points	Yes	Yes	Yes	No	No
- Bezier Curve	Yes	Yes	Yes	No	No
- Circle	Yes	Yes	Yes	No	No
- Circle Arc	Yes	Yes	Yes	No	No
- Ellipse	Yes	Yes	Yes	No	No
- Ellipse Arc	Yes	Yes	Yes	No	No
- Line	Yes	Yes	Yes	Yes	Yes
- Parallel Lines	Yes	Yes	Yes	No	No
- Path Curve	Yes	Yes	Yes	No	No
- Polyline	Yes	Yes	Yes	No	No
- Rectangle	Yes	Yes	Yes	No	No
- Window	Yes	Yes	Yes	Yes	Yes
- Annulus	Yes	Yes	Yes	No	No
- Annulus Arc	Yes	Yes	Yes	No	No
- Bezier Region	Yes	Yes	Yes	No	No
- Elliptical Annulus	Yes	Yes	Yes	No	No
- Elliptical Annulus Arc	Yes	Yes	Yes	No	No
- Rectangle Array	Yes	Yes	Yes	No	No
- Path Enclosed	Yes	Yes	Yes	No	No
- Polygon	Yes	Yes	Yes	No	No
- Rectangular Frame	Yes	Yes	Yes	No	No
- Graphic Manager	Yes	Yes	Yes	Yes	Yes
- Paint Brush	Yes	Yes	Yes	No	No
- Paint Fill	Yes	Yes	Yes	No	No
- Image Overlay	Yes	Yes	No	No	No
Capture -					
- Snap (Video)	Yes	Yes	Yes	Yes	No
- Live (Video)	Yes	Yes	Yes	Yes	No
- First Buffer	Yes	Yes	Yes	Yes	No
- Next Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No
- Previous Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No
- Last Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No
- Adjustments -					
- Snap, Live, Buffer Number	Yes	Yes	Yes	Yes	No
- Resolution (capt.					

window)	Yes	Yes	Yes	Yes	No
- Camera Specific Controls	Yes (F)	Yes (F)	Yes (F)	Yes (F)	No
- Color & White Balance	Yes	Yes	Yes	Yes (N)	No
- Auto Gain Control	Yes (O)	Yes (O)	Yes (O)	No (O)	No
- Load & Save Presets	Yes	Yes	Yes	No	No
- Shortcuts	Yes	Yes	Yes	Yes	No
- GIO Event Capture Single	Yes	Yes	Yes	Yes	No
- GIO Event Capture Sequence	Yes	Yes	Yes	No	No
- Waterfall Display	Yes	Yes	Yes	Yes	No
- RGB Merge	Yes	Yes	Yes	No	No
- Frame Average	Yes	Yes	No	No	No
- Quad Pixel Merge	Yes	No	No	No	No
Sequence Capture (Single Sequence and Continuous Sequence) -					
- to Frame Buffers	Yes	Yes	Yes	Yes (P)	No
- to Frame Buffers at Event	Yes	Yes	Yes	No (Q)	No
- to Memory Buffers	Yes	Yes	Yes	Yes (P)	No
- to Memory Buffers at Event	Yes	Yes	Yes	No (Q)	No
- to Image Files	Yes	Yes	Yes	No	No
- to Image Files at Event	Yes	Yes	Yes	No	No
- to Disk File	Yes	Yes	No	No	No
- to Disk File at Event	Yes	Yes	No	No	No
- to StreamStor (Win)	Yes	No	No	No	No

Notes: (A) For XCAP-Lite, the PIXCI imaging board is assumed installed and open for use. (B) For XCAP-Demo, images can't be loaded or captured, except example image files provided. (C) For XCAP-Lite, images may not be loaded directly from an Internet URL, or saved directly to an FTP URL. (E) For XCAP-Lite, a maximum of 64 Mbytes of PC based frame buffer memory can be used; limit does not apply to PIXCI imaging boards with on-board frame buffer memory. For XCAP-Plus, XCAP-Std, and XCAP-Ltd, software does not impose limitations on use of PC based frame buffer memory, but the maximum available frame buffer memory may be limited by the PC hardware, operating systems, and PC configuration. (F) Camera specific controls provided for most digital cameras supported by PIXCI® D, D24, D32, D2X, CL1, and CL3SD; the 'Camera Info' shows the specific, customized, support provided for each camera. (G) For XCAP-Lite and XCAP-Demo, the View, Palette feature does not include save, load, import, or export. (H) For XCAP-Lite and XCAP-Demo, the Examine, Pixel Peek feature does not include save. (I) For

XCAP-Lite and XCAP-Demo, plotting features do not include statistics, save, or export options. (J) For XCAP-Ltd, XCAP-Lite, and XCAP-Demo, the Modify, Set feature does not include non-rectangular regions. (K) For XCAP-Ltd, XCAP-Lite, and XCAP-Demo, the Measure features do not include calibration. (L) For XCAP-Ltd, XCAP-Lite, and XCAP-Demo, the Line Profile is limited to straight lines. (M) Subject to the amount of frame buffer memory versus image resolution yielding more than one frame buffer. (N) For color cameras with Bayer output with software providing white balance and color corrections: The XCAP-Ltd does not provide more than one set of customized white & black balance settings, automatic white balance (except for SILICON VIDEO® cameras), nor custom color calibration. (O) Software implemented AGC is provided for selected cameras; of those, XCAP-Lite provides AGC only for SILICON VIDEO® cameras. (P) For XCAP-Lite, the Sequence Capture does not include the time stamp feature, nor the strobe features added by software (as selected in the Sequence Capture dialog); any strobe features provided by the PIXCI® imaging board or camera (either inherent or selected in the Capture & Adjust dialog) are available. (Q) For XCAP-Lite, the "triggered" sequence capture is provided when the camera is being triggered (often referred to as "Async Reset Mode"); sequence capture from a free-running camera where the trigger or event is handled separately is not provided. (W95) Feature available only under Windows 95, 98, and ME. (Win5) Feature available only under Windows.

---

7. Specifications

7.1. Signal Input and Output:

EIA RS-644 (LVDS) drivers and receivers are used as the interface circuits.

7.1.1. EIA RS-644 Low Voltage Differential Signaling Devices (LVDS)

National Semiconductor DS90CR288AMTD Channel Link Receiver.
Voltage Input Low Maximum: 0.8 Volts
Voltage Input High Minimum: 2.0 Volts
Absolute Maximum Input Voltage Range: -0.3 volts to +3.6 volts.
Texas Instruments SN65LVDM176D driver/receiver.
Voltage Output Low Minimum: 0.9 Volts.
Voltage Output High Maximum: 1.6 Volts.
Absolute Maximum Output Voltage Range: -0.3 volts to +3.6 volts.
Voltage Input Low Maximum: 0.8 Volts
Voltage Input High Minimum: 2.0 Volts
Absolute Maximum Input Voltage Range: -0.3 volts to +3.6 volts.

7.1.2. Resolution:

The number of pixels and lines is determined by the camera.

7.1.3. Frame Rate

The frame rate of the camera determines the frame rate of the PIXCI® CL3SD.

7.1.4. Bus Requirements

32 bit, 33 MHz PCI bus master, 3.3 or 5 volt PCI slot.
3.6 Amps @ +3.3 or +5 Volts
13.5 inches long (including plastic slot support) by 6.0 inches high (with 4 gigabytes of memory installed).
Requires a motherboard with 3.3 volt power on the PCI bus. A motherboard with an AGP slot for the display system adapter or AGP on the motherboard is suggested. Most motherboards manufactured since 2001 should operate correctly with the PIXCI CL3SD. Contact EPIX for additional information on compatibility of specific motherboards.

7.1.5. Operating Systems

XCAP: Windows XP, NT, and 2000 supported.
XCLIB: XP, NT, 2000, Linux.

7.1.6. Display - Windows

At least a 24 bit per pixel Windows compatible display system. Display resolution as per installed display system device driver.

7.1.7. Connections

6 pin LEMO EGG.0B.306.CLL connector is used for trigger input, +5 volt trigger power output, and multiple board trigger output.
26 pin 3M MDR connectors for Camera Link.
Cables optionally available.

Specifications subject to change without notice.

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8. Trigger and Camera Integration Control Registers

The trigger and camera integration control registers generate the CC1 signal to the camera via the Camera Link cable. The CC1 signal can be generated in response to an external rising or falling edge trigger input, in response to a write to the EXSYNC register, or can be continuously running.

Two 16 bit counters and a pixel clock divider determine the timing of the CC1 signal. The EXSYNC counter determines the width of CC1 while the PRIN counter determines the time from the end of CC1 to the start of the next CC1. EXSYNC is used to program the exposure width, while PRIN is used to program the time for readout of the sensor. Some camera modes do not use the width of the CC1 signal, instead they use the edge of CC1 to start an exposure and readout with the exposure controlled internally by the camera.

8.1. PRIN and EXSYNC Bit Definitions

PRINC. Trigger Control and PRIN Delay Count. Write Only. 32 bits.
0x0000 on power up.
Bits 31 thru 16 control the width of PRIN.
0x0000 on power up.

Bits 9-7, EPCD, Exposure Pixel Clock Divide.
Selects one of 8 outputs of the Pixel Clock divide counter that clocks the camera control state machine clock.
9,8,7=111 selects Pixel Clock divide by 512.
9,8,7=110 selects Pixel Clock divide by 256.
9,8,7=101 selects Pixel Clock divide by 128.
9,8,7=100 selects Pixel Clock divide by 64.
9,8,7=011 selects Pixel Clock divide by 32.
9,8,7=010 selects Pixel Clock divide by 16.
9,8,7=001 selects Pixel Clock divide by 8.
9,8,7=000 selects Pixel Clock divide by 4.

Bit 4, TRIGNEG, Trigger Input Polarity Select.
Bit 4=1 selects a 1 to 0 transition of the Trigger input.
Bit 4=0 selects a 0 to 1 transition of the Trigger input. The trigger input is on the LEMO and P3 connectors.

Bit 2, EXPS, EXSYNC Polarity Select.
Bit 2=1 selects a positive CC1 pulse.
Bit 2=0 selects a negative CC1 pulse. The EXSYNC signal is connected to CC1.

Bit 1, CNTS, Continuous Select.
Bit 1=1 selects continuous operation of the EXSYNC state machine. If TIS=1, a trigger will generate an EXSYNC that is the width of the EXSYNC count down time, load the PRIN count, count down the PRIN count, and wait for the next trigger input. If TIS=0, the state machine will run continuously, counting down the EXSYNC (and generating CC1), then counting down PRINC, and looping.
Bit 1=0 selects single shot operation of EXSYNC. Each time the EXSYNC register is written, one EXSYNC pulse will be produced while the EXCYNC is counted down, followed by the PRINC count down. Each EXSYNC write will start this cycle.

Bit 0, TIS, Trigger Input Select.
Bit 0=1 causes the start of EXSYNC to be delayed until the trigger input goes from 0 to 1 (if TRIGNEG =1) or 1 to 0 (if TRIGNEG =0). CNTS must be =1 for TIS=1 to operate.
Bit 0=0 ignores the trigger input and causes the EXSYNC to be loaded after both counters have counted down (if CNTS =1), or wait for next write of EXSYNC (if CNTS =0).

EXSYNC. EXSYNC Count. Write Only. 32 bits.
0x0000 on power up.
Bits 31 thru 16 controls the width of EXSYNC.

8.2. Camera Timing Formula and Examples

Exposure is determined by the formula:
Exsync = (Camera_clock x Exposure) / (4 x 2^N)
Prin = Camera_clock x (Frame_time - Exposure_time - 2 x 10^{-6}) / (4 x 2^N)

Note that the value of the pixel clock divider, N, must be the same for both Exsync and Prin calculations. The Exsync and Prin counters are 16 bits and the value of Exsync and Prin must be less than 65535 (decimal) and greater than 0.

Note that the camera clock of the A504k or A504kc is 67.58 MHz.

The results of the examples that follow are rounded to the nearest whole number.

8.2.1. PRIN and EXSYNC Calculations Example 1

For an exposure_time of 2 milliseconds and a frame rate of 200 Hz (5 milliseconds) with N=0:
Exsync = (67.58 x 10^6 x 2 x 10^{-3}) / (4 x 2^0) = 33790.
Prin = 67.58 x 10^6 x (5 x 10^{-3} - 2 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^0) = 50651.

8.2.2. PRIN and EXSYNC Calculations Example 2

For an exposure time of 4 milliseconds and a frame rate of 50 Hz (20 milliseconds)with N=0:
Exsync = (67.58 x 10^6 x 4 x 10^{-3}) / (4 x 2^0) = 67580 (greater than 65535).
Prin = 67.58 x 10^6 x (20 x 10^{-3} - 4 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^0) = 270286 (more than 4 times greater than 65535).
Since the frame rate requires a divisor for the pixel clock, a divisor of N=3 is chosen.
Recalculating:
Exsync = (67.58 x 10^6 x 4 x 10^{-3}) / (4 x 2^3) = 8448.
Prin = 67.58 x 10^6 x (20 x 10^{-3} - 4 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^3) = 33786.

8.3. XCLIB Trigger and Camera Integration Register Programming

The EXSYNC and PRIN are set by loading a video configuration format file previously saved by XCAP, via

```
pxd_PIXCIopen(...)
```

or

```
pxd_videoFormatAsIncluded(...);
```

The EXSYNC and PRIN 16 bit count values, which are the upper 16 of the 32 bit registers, can

set and queried in the XCLIB library with functions:

```
int  pxd_setExsyncPrin(int unitmap, uint exsync, uint prin);
uint pxd_getExsync(int unitmap);
uint pxd_getPrin(int unitmap);
```

The lower 16 bits of these registers can be queried and set in the XCLIB library with functions:

```
int  pxd_setExsyncPrincMode(int unitmap, uint exsyncbits, uint princbits);
uint pxd_getExsyncMode(int unitmap)
uint pxd_getPrincMode(int unitmap);
```

Only those bits which control the scaling of EXSYNC and/or PRIN values, or similar features should be changed by using *pxd_setExsyncPrincMode*. Other features, such as a change to resolution, or trigger mode also require a change to the video format configuration, which this function does not automatically perform. Use of *pxd_PIXCIopen* or *pxd_videoFormatAsIncluded* with a video format configuration exported by XCAP should be used to effect change to all EXSYNC and PRINC values and bits.

See the *XCLIB Reference Manual* for additional information.

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9. In Case of Trouble

9.1. XCAP Error Messages

After XCAP is started and the PIXCI CL3SD board is ``opened'', XCAP performs memory and board diagnostics. If any of the diagnostics fail, an error message will be displayed.

If a ``Data Path Error'' message is displayed, the board must be returned for repair.

9.2. Hardware Problems

Some problems do not cause software error messages. Some problems may prevent the computer from powering up. Some problems may prevent the software from accessing the PIXCI imaging board. These types of problems can be due to:

Power Supply	Insufficient power for the boards installed.
Touching Boards	One board's components are touching another board.
Defective Cable(s)	Camera cable has an open or short.
Video Input	Defective camera.
Defective PIXCI imaging board	Defective integrated circuit, bad solder joint, physical damage, or static damage.

Motherboard	Defective PCI connector. PCI slot is not bus master capable. PCI slot shares interrupts or other resources with another slot.

9.2.1. Power Supply Problems

The PC power supply usually has a printed rating of power available for the four standard PC voltages. The PIXCI imaging board uses significant current from the +3.3 or +5 volt supply. If other devices and the PIXCI imaging board use more power than the power supply can provide, the power supply will shut down. In marginal situations, this may not happen until an operation is performed that requires additional power, such as capturing an image sequence. Try removing non-essential boards from the system.

9.2.2. Touching Boards

If the components of one board touch those of another, damage to one or both boards can occur. Move one of the touching boards at least one slot away from the other.

9.2.3. Defective Cable

If the camera cable is broken or shorted, the board may not function or may intermittently function.

- Try another cable.
- Test the cable for shorts or opens with an ohmmeter.

9.2.4. Camera Input

If the camera is defective, has the lens closed or covered, or has the exposure set for a time that is too short for the amount of light available, a black image will be captured.

- Select the ``Modify'' menu and select ``Patterns.'' Write a test pattern to image memory which will be displayed on the monitor. Snap an image to see if the test pattern is written over by the camera's video data. If the test pattern is not overwritten, the camera, camera cable, or camera power supply may be defective.
- If the test pattern is overwritten, the camera lens may be closed, the cap may be covering the lens, or the exposure may be too short.
- Select the camera test pattern output and check for correct image display.

9.2.5. Motherboard

- If the motherboard does not provide +3.3 volts for the PCI slots (against the PCI

specification), the board can be damaged when the PC is powered up. Call EPIX for a list of suggested motherboards or for a complete tested computer system.

- The PCI bus connector on the motherboard may be defective. Try another PCI bus slot or another motherboard.
- The PCI bus slot may not support a PCI master. Try another PCI bus slot or another motherboard.
- The PCI bus slot may be wired to share interrupts or other slot resources with one of the adjacent slots. Try another PCI bus slot or another motherboard.

9.2.6. Graphics Display System

If the graphics display system has insufficient memory, is not a PCI board, does not support PCI burst mode, or the XCAP software does not operate correctly, try another graphics display system. Call EPIX for a list of suggested graphics display adapters.

9.3. If All Else Fails

If none of the above suggestions have solved the problem, call your distributor (if you purchased the board thru a distributor), or FAX or e-mail EPIX for technical support. In the FAX or e-mail, include error messages that were displayed, describe symptoms observed, and steps taken to attempt to solve the problem. It is helpful to call from a phone near the computer with the PIXCI imaging board installed.

The PIXCI imaging board can be damaged during shipment. If damage is visible, check the shipping container for damage, and notify the freight carrier.

If the board must be returned for test or repair, call EPIX for a Return Materials Authorization (RMA) number. Be prepared to describe the problem that has been encountered and what steps have been taken to attempt to correct it. Please include a written description of symptoms, error messages, and steps taken to attempt to solve the problem. Please provide a packing list for the material returned and carefully pack the PIXCI CL3SD at least as good as it was when received at your dock.

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10. Hardware Revision Description

10.1. PIXCI CL3SD Revisions

PIXCI CL3SD Revision list

1. Revision 0.0: Board not released.

2. Revision 1.0: First release.
   Removed resistor packs between 5232 and 6500.

3. Revision 2.0:
   Fixed PCB layout error.
   Added LEMO connector P5.
   Combined previous P5 and P6 connectors into single P6 test connector.
   Rotated headers P3 and P4 so they match the orientation of other PIXCI boards.
   Added bus mastering for PCI transfers.

4. Revision ALL:
   Boards shipped prior to October 2002 may have jackscrews which are too long for complete cable seating. Replacements are available.

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11. Tips: PIXCI® CL3SD and Basler A504k(c)

XCAP combined with the PIXCI® CL3SD and Basler A504k(c) will operate without any special configuration issues, allowing capture of images at 500 to 16,000 frames per second. The following provides tips to fine-tune the system.

These tips also provide explanations of what special options should be set on behalf of the PIXCI® CL3SD, and the effect if they are not. These explicit instructions may be useful if a different PIXCI® imaging board was previously installed before being replaced by a CL3SD; while XCAP will always change any invalid settings remembered from previous use to accommodate a different imaging board, it will remember and use any valid but suboptimal settings as being the user's choice and whim.

11.1. Time Stamps

The time stamp feature of:

```
-- from PIXCI® Image Viewer --
Capture
Video to Frame Buffers
```

(or see *Capture - Video to Frame Buffers* in the *XCAP Reference Manual*) records the system time at which each image is captured.

Time stamping in conjunction with video rate capture requires that sufficient, so-called, "image frame buffer memory" be reserved in:

```
-- from Main Window --
PIXCI
PIXCI Open/Close
Driver Assistant
Set Frame Buffer Memory Size
```

(or see *Windows 2000/XP - Frame Buffer Memory Allocation* or *Windows NT - Frame Buffer Memory Allocation*). Without reserved memory, the same length of sequences of images can be captured at the same rate, but time stamps will not be recorded when using *Live Video at Video Interval*. Time stamps will be recorded if using the sub-video rate *Snap Video at Time Interval* or *Snap Video at Video Interval* feature.

Normally, time stamps are based on a Windows kernel service that provides low resolution time stamps with low overhead. The resolution obtained is dependent on the underlying PC hardware and not specified by Windows; typical observed values are 16 millisec. Selecting:

```
-- from Main Window --
PIXCI
PIXCI Open/Close
Advanced
High Resolution Time Stamping
```

(or see *PIXCI® - Advanced*) selects use of a Windows kernel service that provides higher resolution time stamps; alebit with a warning that system efficiency may decrease. The resolution obtained is dependent on the underlying PC hardware and not specified by Windows; typical observed values are less than one microsecond.

The time stamp is recorded by PIXCI® software, not hardware in response to a hardware interrupt. The stamp's accuracy will be lower than that of the underlying kernel service, and may vary from image-to-image due to varying interrupt latency.

By default, XCAP displays time stamps in the format:

```
69.12.31 18:00:00.000
```

i.e. year, month, and day followed by hour, minute, second, and millisecond. If display of microseconds is desired, select an alternate format by:

```
-- from Main Window --
Utility
Window Style
Date/Time (a tab)
Date Format
```

and set *Date Format* to

```
69.12.31 18:00:00.000.000
```

(or see *Utilities - Window Style*).

Under Windows 2000 and XP, upon initial installation of a PIXCI® CL3SD, 4 Mbytes of "image frame buffer memory" is reserved and the *High Resolution Time Stamping* is enabled. Under Windows NT which lacks Plug & Play, 16 Mbytes of "image frame buffer memory" is reserved and the *High Resolution Time Stamping* is not enabled; the same default settings as all other PIXCI® imaging boards. The default *Date Format* is:

```
69.12.31 18:00:00.000
```

11.2. Video Display

Because the camera's capture rate is much faster than the computer's display rate, during preview of live video of an fast moving object, the displayed image may appear *broken* into several horizontal bands. Each band represents the contents of a different video frame.

Selecting:

```
-- from PIXCI® Image Viewer --
View
Display
Live Mode (a tab)
Live Video: Snap, Display, Snap
```

(or see Capture - Live Options) will improve the appearance of the live display preview, albeit at a slightly slower display rate. Selecting

```
Live Display: From Buffer Copy
```

may increase the live display rate, especially with use of a color camera.

11.3. Clearing All Buffers

Some motion analysis users are accustomed to clearing all buffers of previously captured images before capturing a new sequence. While not necessary with the PIXCI® CL3SD - capturing a new sequence overwrites the previous buffer contents - some may still prefer explicitly clearing the buffers.

Using:

```
-- from PIXCI® Image Viewer --
Modify
Sequence ...
Sequence Set
OK
```

will clear all of the buffers by writing a specified grey level to all pixels, but will require several minutes due to the large size of the frame buffer memory.

A quicker alternative is in the Capture & Adjust dialog:

```
-- from PIXCI® Image Viewer --
Capture
Adjustments
```

if not already shown, then:

```
Adj2 (a tab)
Clear Buffers
```

The *Clear Buffers* sets the camera to a white test pattern, captures a sequence at video rate into all buffers, and resets the camera to its previous mode.

11.4. Saving Image Sequences

The

```
-- from PIXCI® Image Viewer --
File
```

Save Image Sequence

(or see *Image File - Save Sequence*) allows saving a captured sequence either as a single file, such as in TIFF or AVI format, or as a sequence of individual files. There are no special tips if using the latter, or using the former with a PIXCI® CL3SD with 1 Gbyte of memory - other than making sure there is sufficient disk space available.

If saving 2 to 4 Gbytes to a single AVI or TIFF file, several warnings are appropriate. First, some applications will not accept an AVI file larger than 2 Gbyte.

Second, saving 4 Gbytes of frame buffers in an uncompressed and lossless TIFF or AVI format would result in a file size slightly larger than 4 Gbytes, as there is additional overhead in both the TIFF and AVI file formats. XCAP software is limited to a file size of 4 Gbytes. A 4 Gbyte image sequence should be saved as two TIFF or AVI files, or each image saved as an individual TIFF, BMP, or other format file.

---

12. TTL Module for the PIXCI CL3SD

The TTL Module is a printed circuit board with an LVDS (RS-644) differential driver. It has two DB-9 subminiature connectors. One DB-9 female connector is for the TTL trigger input. The other DB-9 female connector is for the differential output and the +5 volt power from the PIXCI CL3SD. Each connector is labelled with TTL or DIF.

The TTL Module is enclosed in a plastic case which measures 10.5 x 4.3 x 2 centimeters. A 2 meter cable between the PIXCI CL3SD and the TTL Module is included. Longer cables can be custom ordered.

To take the most advantage of the lower noise obtained by using differential signaling, the TTL Module should be placed close to the TTL trigger source.

12.1. Pin Description: TTL Trigger Input, Female DB9

Pin Number	Signal Name
1	Ground
2	No connection
3	No connection
4	No connection

5	No connection
6	+5 Volts
7	TTL Trigger Input
8	Not used
9	Not used

---

13. Certification and Warranty

13.1. Certification and Testing

The PIXCI® CL3SD imaging board has NOT been tested per EMC directive 89/336/EEC and has NOT met the following test requirements:

- EN 50081-1/01.92,
- EN 55022/08.94 class B
- EN 61000-4-2/03.95
- ENV 50204/03.95

These test are more commonly known as the ``CE'' test. The testing was performed to class B which has a more restrictive emission limit than the FCC class B limit.

If you find that the computer system in which the PIXCI® CL3SD is installed is causing interference with other devices, try increasing the distance between the devices, reorienting (turning) the devices, or using additional shielding on the computer system (such as placing covers on the computer and installing metal shields in unused slots or over unused drive slots).

The camera connected to the PIXCI® CL3SD may be the source of radiation. To determine if the camera is the source of interference, remove power to the camera or reorient the camera. If a shielded camera cable is not being used, use a shielded cable. If the camera is the source of interference, contact the camera manufacturer.

13.2. Limited Warranty

EPIX, Inc. warrants to the original purchaser of the PIXCI® CL3SD board that the PIXCI® CL3SD board shall be in good working order for a period of one year from the date of shipment from EPIX, Inc. Should this product fail to be in good working order at any time during this one

year warranty period, EPIX, Inc. will, at its option, repair or replace this product at no additional charge except as set forth below. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts and products become the property of EPIX, Inc.
This limited warranty does not include service to repair damage to the product resulting from accident, disaster, misuse, abuse, or non-EPIX, Inc. modification of the product.
Limited warranty service may be obtained by delivering the product during the one year warranty period to an EPIX, Inc. distributor or to EPIX, Inc. and providing proof of the purchase date. Insure the product or assume the risk of loss or damage in transit. Prepay shipping charges to EPIX, Inc. or to the distributor. Use the original shipping container, or the equivalent, and static dissipative packaging material.
EPIX, Inc. hereby disclaims all other express and implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose. Some states do not allow the exclusion of implied warranties, so the above limitations may not apply to you.
If this product is not in good working order as warranted above, your sole remedy shall be repair or replacement as provided above. In no event will EPIX, Inc. be liable to you for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use of or inability to use such product, even if EPIX, Inc. or an authorized EPIX, Inc. distributor has been advised of the possibility of such damages, or for any claim by any other party.

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14. Footnotes

[1]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[2]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[3]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[4]
Depending upon the user environment setup, you may have to enter "./anypgm.bin" instead of "anypgm.bin" to execute a program from the current directory.

[5]
Of course, while using XCAP all images, scripts, and other data can be explicitly saved whereever desired.

[6]
The identification code is provided on a card enclosed with the CD or diskette(s), and is also shown on the packing list. The card and the identification code may be required as proof of purchase for future software upgrades. Keep the card in a safe place!!

[7]
XCAP-Plus, XCAP-Std, and XCAP-Ltd also require an authorization key to activate all features.

[8]
The required "XCAP Sourcery" TWAIN driver is a separate software product and is not included with XCAP.

[9]

The required "XCAP Sourcery" Image-Pro driver is a separate software product and is not included with XCAP.